Vector-Borne Diseases in California

2006
ANNUAL REPORT

Vector-Borne Disease Section
California Department of Public Health

California Department of PublicHealth

2006

ANNUAL REPORT

VECTOR-BORNE DISEASE SECTION

INFECTIOUS DISEASES BRANCH

DIVISION OF COMMUNICABLE DISEASE CONTROL

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH

The Great Seal

Arnold Schwarzenegger
Governor
State of California

Kimberly Belshé, Secretary
Health and Human Services Agency

Mark B Horton, MD, MSPH, Director
Department of Public Health

2006

ANNUAL REPORT

VECTOR-BORNE DISEASE SECTION

Table of Contents

Acknowledgements

Annual Report technical assistance
Linda Sandoval

Vector-Borne Disease Section student assistants
Yaffa Alter, Albert Do, Eduard Flores, Erin Garcia, Amy Huang, Kathreen Khavari, Anna Kim, Jennifer Kim, Laura Leypoldt, Daniel Li, Jeffrey Lo, Greg Nishimura, Rachel Owens, Sarah Pool, Carlos Rivas, Karlo Sabio, Elizabeth Sigman, Steven Simpson, Jr., Jensine Thomas, Clarisse Tsang, Elizabeth Wright.

Rodent-borne disease surveillance
U.S. Centers for Disease Control and Prevention (CDC); United States Forest Service; Coachella Valley Mosquito and Vector Control District (MVCD); Contra Costa MVCD; Los Angeles County Department of Public Health (DPH); Mono County Health and Human Services (HHS); Northwest MVCD; Orange County Vector Control District (VCD); Riverside County Vector Control Program (VCP); San Bernardino County VCP; San Diego County HHS and Vector Surveillance and Control Program (VSCP); Santa Clara County VCD; Viral and Rickettsial Diseases Laboratory Branch (VRDL), California Department of Public Health (CDPH).

Flea-borne disease surveillance
Division of Viral and Rickettsial Diseases, CDC; U.S. Department of Agriculture/Animal and Plant Health Inspection Service, Wildlife Services; U.S. National Park Service, Yosemite National Park; U.S. Department of Defense, Vandenberg Air Force Base; Alameda County Vector Control Service District; Fresno County Department of Agriculture; Inyo County Environmental Health Services; Kern County Environmental Health Services (EHS); City of Long Beach Department of Health and Human Services; Los Angeles County DPH; Mono County HHS and Environmental Health; Orange County VCD; Riverside County EHS; San Diego County Public Health Services; San Mateo County VCD; School of Veterinary Medicine, University of California, Davis (UCD); Microbial Diseases Laboratory Branch, CDPH.

Tick-borne disease surveillance
United States Army Center for Health Promotion and Preventative Medicine-West; CDC; Riverside County VCP; San Mateo County Mosquito Abatement District (MAD); Contra Costa County MVCD; Ventura County Environmental Health Department; Santa Barbara VCD; Los Angeles County DPH; Los Angeles County West VCD; Placer County MVCD; Sacramento-Yolo MVCD.

Mosquito-borne disease surveillance
CDC; Veterinary Public Health Section and VRDL, CDPH; Center for Vectorborne Diseases, UCD; California Animal Health and Food Safety Laboratory; California Department of Food and Agriculture; Lindsay Wildlife Museum; Center for Advanced Research of Spatial Information, Hunter College of The City University of New York, NY; Mosquito and Vector Control Association of California; participating local mosquito and vector control agencies, local health departments, and physicians and veterinarians.

California Department of Transportation (Caltrans) project collaboration
Caltrans; California State University, Sacramento; Office of Water Programs & Caltrans Stormwater Projects; University of California, Riverside, Aquatic Entomology Laboratory; El Dorado County Vector Control; Placer County MAD; Greater Los Angeles County VCD; Orange County VCD; San Diego County VSCP; Sacramento-Yolo MVCD; City of Elk Grove Public Works Department; San Bernardino County VCP; County of San Bernardino Flood Control District.

Other vectors and public health pests
California Department of Food and Agriculture; Coachella Valley MVCD; Orange County VCD; Los Angeles County Agricultural Commissioner/Weights & Measures.

VBDS reports and public information materials
Claudia Erickson

State of California—Health and Human Services Agency
California Department of Public Health

MARK B HORTON, MD, MSPH
Director

ARNOLD SCHWARZENEGGER
Governor

I am pleased to submit to you the 2006 Annual Report for the Vector-Borne Disease Section (VBDS) of the California Department of Public Health. VBDS staff conducted surveillance, prevention, and control of existing and emerging vector-borne diseases throughout California in 2006.

Widespread West Nile virus (WNV) activity was documented in California in 2006, but the number of human cases (278) was fewer than during the previous two years. Undoubtedly, the infusion of $12 million in 2005 and $3 million in 2006 to enhance and expand mosquito control in California was paramount in minimizing morbidity and mortality; VBDS was instrumental in securing and efficiently and effectively allocating these funds. VBDS staff worked extensively with local agencies to initiate mosquito control programs in regions of the state previously without such services, including Amador, Calaveras, Lassen, Nevada, and San Benito Counties. We continued to successfully coordinate the WNV surveillance program and enhanced outreach to the public with new educational materials.

VBDS documented extensive plague activity in the Eastern Sierra in 2006. Two human plague cases were reported and our biologists worked closely with local public health officials to investigate circumstances surrounding these cases. There was also significant hantavirus activity in 2006, with four human cases reported, three of which were fatal. VBDS evaluated exposure risk to plague and hantavirus in numerous localities and made risk reduction recommendations, especially on U.S. Forest Service (USFS) lands.

In collaboration with the Centers for Disease Control and Prevention, we identified for the first time in California the agent of Rocky Mountain spotted fever, *Rickettsia rickettsii*, in brown dog ticks. Our California Epidemiologic Investigation Service (Cal-EIS) Fellows completed an evaluation of occupational exposure to ticks among USFS employees and assessed mosquito production in stormwater treatment structures in the Tahoe region under a contract with the California Department of Transportation.

Many of you are our collaborators and colleagues and I hope that you find the information contained in this annual report to be of value as we collectively strive to promote and protect the health of all Californians.

Respectfully,

Vicki L. Kramer, Ph.D., Chief
Vector-Borne Disease Section

Introduction

The mission of the California Department of Public Health Vector-Borne Disease Section (VBDS) is to protect the health and well-being of Californians from insect- and vertebrate-transmitted diseases and injurious pests. VBDS provides leadership, information, and consultation on vector-borne diseases to the general public and agencies engaged in vector control activities.

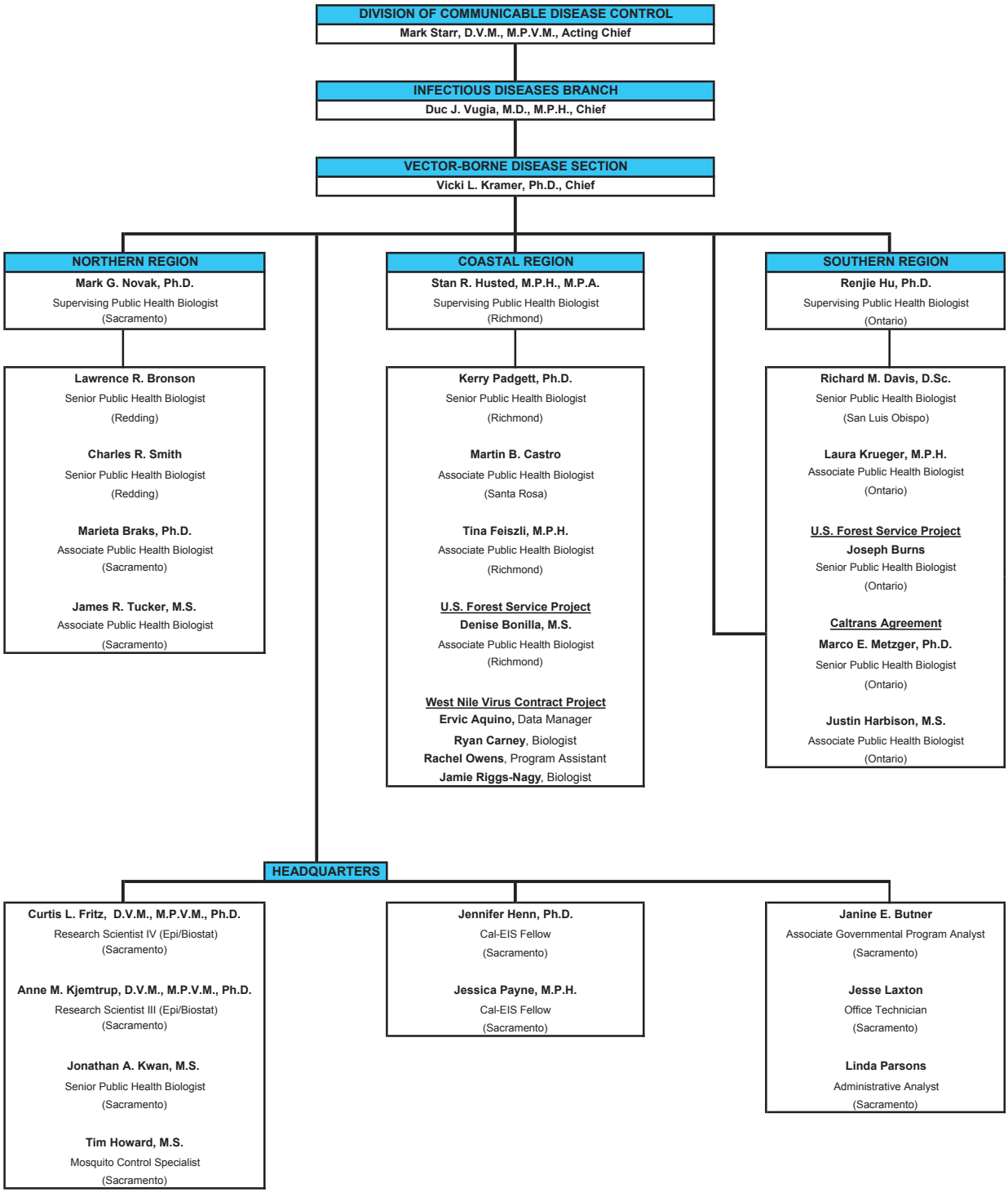
VBDS staff, located in six regional offices and headquartered in Sacramento, provide the following services:

- Develop and implement statewide vector-borne disease surveillance, prevention, and control programs
- Design and conduct scientific investigations to further knowledge of vector-borne diseases in California
- Coordinate preparedness activities for detection and response to introduced vectors and vector-borne diseases, such as West Nile virus
- Conduct emergency vector control when disease outbreaks occur
- Administer public health exemptions in disease outbreaks where applicable under the Endangered Species Act
- Advise local agencies on public health issues related to vector-borne diseases
- Oversee local vector control agency activities through a Cooperative Agreement
- Oversee the Vector Control Technician Certification and Continuing Education programs
- Provide information, training, and educational materials to governmental agencies and the public
- Provide assistance in coordinating issues related to the management of Africanized honey bees and red imported fire ants
- Advise local governmental agencies, schools, and the public on head lice management
- Maintain the San Francisco Bay Area U.S. Army Corps of Engineers general permit, which allows local vector control agencies to conduct abatement activities
- Oversee Special Local Need permits on restricted use of public health pesticides

This report summarizes surveillance and control activities for plague, hantavirus pulmonary syndrome, and mosquito- and tick-borne diseases in 2006. Activities conducted in the National Forests of California to protect U.S. Forest Service (USFS) personnel and visitors from vector-borne diseases are included in this report; USFS provides support for these activities through a cost-share agreement. Results from a special project with the California Department of Transportation to examine vector production in stormwater treatment devices are described. VBDS oversees the Vector Control Technician Certification Program; data summarizing the number of exams administered by VBDS and the number of vector control technicians in each certification category are provided. As education and training are important components of a vector-borne disease prevention program, a summary of the many presentations and reports prepared by VBDS staff is included. Many of the state and local agencies with which VBDS collaborated in 2006 are listed in the Acknowledgements section.

Authorizing statutes include: Health and Safety (H&S) Code §116108-116120; H&S Code §116102, et. seq.; H&S Code §116180; Government Code §12582.

Personnel
December 2006



Other VBDS staff during part of 2006: **Megan Henry**, 05-06 Cal-EIS Fellow (Sacramento), **Al Hom**, Senior Public Health Biologist (Richmond), **Lauren Marcus**, Biologist (Richmond), **Lottie Rhoades**, Office Technician (Sacramento), **William Unger**, Office Assistant (Sacramento),

Source: California Department of Public Health

Rodent-borne Disease Surveillance

Hantavirus pulmonary syndrome (HPS) in California residents
Four cases of HPS were diagnosed in California residents in 2006.

Los Angeles County, July 2006
A 52-year-old white male was admitted to Washoe Medical Center in Reno, Nevada, in early July with shortness of breath, wheezing, and cough. Admission thoracic roentgenograms noted hypoinflation interpreted as atelectasis or infiltrate. The patient was intubated and placed on a ventilator, but died on the Day Nine of hospitalization. The Nevada State Health Laboratory reported detecting elevated (>1:6400) IgM and IgG titres to Sin Nombre virus (SNV) in a serum specimen collected on Day Five. These results were confirmed at the Special Pathogens Branch, U.S. Centers for Disease Control and Prevention.

The case-patient had camped in a trailer in the Humboldt-Toiyabe National Forest, Mono County, during the three weeks preceding onset. In early August, staff of the California Department of Public Health (CDPH) Vector-Borne Disease Section (VBDS) conducted a site inspection and rodent surveillance at the campground. Ninety Sherman traps set at several campsites and inside buildings yielded 81 rodents. The CDPH Viral and Rickettsial Disease Laboratory Branch (VRDL) reported detecting serum antibodies to SNV in 19 of 41 deer mice (*Peromyscus maniculatus*), including four of seven that were trapped from within the two campsites the case-patient occupied, and one of two voles (*Microtus montanus*). A second field surveillance effort conducted at the campground in October 2006 failed to recover any rodents.

Los Angeles County, August 2006
A 16-year-old Hispanic male presented to a local emergency clinic in July with complaints of severe headache, cough, and shortness of breath. Abnormalities noted at admission included hypotension, tachycardia, thrombocytopenia, and hypoxemia. The patient was sedated, intubated, and provided 100% oxygen and mechanical ventilation. Thoracic roentgenography revealed bilateral interstitial infiltrates. The patient died two weeks after admission. The VRDL reported detecting elevated IgM and IgG serum antibodies to SNV. Lung tissue collected at post-mortem was negative for SNV by polymerase chain reaction (PCR) conducted at VRDL.

Information provided by the case-patient's family indicated no travel or contact with animals, including rodents, in the weeks preceding onset. In mid August, staff of the Los Angeles County Department of Public Health Vector-borne Disease Surveillance Unit conducted visual inspection or rodent collection around the case-patient's residence, worksite, and other areas he reportedly visited. No rodents were captured in the natural area west of his residence. Eight rodents (including three *P. maniculatus*) were captured near a friend's residence. No evidence of rodents was observed at other sites evaluated. A second surveillance effort one week later recovered six rodents (including one *P. maniculatus*) from the friend's residence and two rodents (including one *P. maniculatus*) from near the case-patient's worksite. No rodents were collected near the case-patient's residence or school. Of the five *P. maniculatus* collected, one from the friend's residence was positive for SNV by both serology and PCR conducted at VRDL.

San Diego County, October 2006

In late October, a 55-year-old female presented to a local clinic with fever and shortness of breath of two days' duration. She reported also having nausea, vomiting, and diarrhea of approximately two weeks' duration. On physical exam, she was noted to have fever, mild tachycardia, and diffuse petechiae on her lower extremities. Bibasilar crackles were noted and thoracic roetgenography revealed bilateral infiltrates. The patient was hospitalized for intensive care and cardiopulmonary support, but died within a few days of admission. The VRDL detected IgM antibodies to SNV in a serum specimen collected at admission and SNV DNA in kidney and lung tissues by PCR.

The case-patient had been traveling throughout the northwestern United States for approximately six months. Staff of the San Diego County Health and Human Services attempted to reconstruct the case-patient's itinerary through review of written records and interviews with friends and other contacts. The available information indicated that the case-patient traveled in Wyoming from mid-August through at least early September, was in Utah in mid-October, and returned to southern California in late October. The case-patient had reported extensive rodent infestation of the camper-trailer and contact with live rodents and rodent excreta. Staff of San Diego County Vector Surveillance and Control conducted an inspection of the camper-trailer. Inspection verified extensive rodent infestation and contamination. Attempts at rodent collection yielded only one *P. maniculatus*. Serum from this rodent was positive (>1:6400) for antibodies to SNV and PCR of cardiac tissue was positive for SNV DNA.

San Bernardino County, September 2006

In early September, a 55-year-old female presented to an emergency department in Denver, Colorado, with an approximately four-day history of progressive severe headaches, fever, chills, hypotension, shortness of breath, and a dry cough. At admission the patient was noted to have thrombocytopenia and bilateral patchy infiltrates on thoracic roentgenogram. The Colorado Department of Public Health Laboratory detected IgM antibodies to SNV.

The patient was a recent California resident who left her residence in San Bernardino County to move to Colorado three days prior to onset. The patient first noted symptoms of chills, fever, and headache while en route to Colorado. The patient formerly resided at a camp in the San Bernardino mountains. The patient reported heavy rodent infestation during the preceding year, including noting mouse droppings in her residence and the lodge and cabins. She observed live and dead mice in the garage in mid August while packing for the move. The San Bernardino County Vector Control Program, in cooperation with VBDS, inspected and conducted rodent surveillance at the camp on on three dates in September and October. Evidence of rodent infestation was observed throughout the camp, including staff residences, cabins, storage facilities, and equestrian stables. A total of 61 rodents were collected within and outside buildings, including one *P. eremicus* and one *P. boylii* from the case-patient's garage and attic, respectively. Sera from 56 rodents, including 19 *P. maniculatus*, were tested at the VRDL for antibody to SNV; none was positive. Recommendations were made to the camp management regarding rodent-proofing facilities, maintaining routine rodent trapping and removal, and decreasing incentives (e.g., open food containers) for rodents in living areas.

Since 1993, HPS has been diagnosed in 47 California residents. Four of these were identified retrospectively, with onset of illness having occurred in 1980, 1984, and 1992 (2). An additional two California residents were diagnosed with acute SNV infection without pulmonary manifestations. The median age of all 49 case-patients was 42 years (range, 12 to 74 years) and 28 were male. Case-patients were residents of 19 counties--Alameda, Alpine, Contra Costa (2), Inyo (6), Kern (4), Los Angeles (4), Modoc, Mono (9), Nevada (3), Plumas (2), Sacramento, Santa Barbara (2), San Bernardino (2), San Diego (2), San Francisco, Santa Clara (2), Sierra, Ventura (2), and Yolo (2). Probable and possible sites of exposure included the counties of Alameda, Alpine (2), Fresno, Inyo (7), Kern (4), Los Angeles, Modoc, Mono (12), Nevada (3), Placer, Plumas (2), San Bernardino (2), San Diego, Santa Barbara, Sierra, and Tuolumne, and the states of Arizona, New Mexico (3), Utah, and Washington. Eighteen (37%) cases had a fatal outcome.

Surveillance for hantavirus in California rodents

In 2006, 2,498 rodents were collected and serologically tested for SNV antibody, representing at least 17 species from eight genera (Table 1). At least one seroreactive rodent was detected in 11 of 14 California counties in which surveillance was conducted in 2006. Of 2,274 *Peromyscus* spp. collected, 224 (9.9 %) had serologic evidence of infection with SNV. Seroprevalence was highest in *P. maniculatus* at 15.7 percent. Active surveillance since 1993 and retrospective analysis of rodent specimens captured since 1975 have identified serologic evidence of SNV infection in 13.2 percent of *P. maniculatus* statewide. At least one seroreactive *P. maniculatus* specimen has been identified in 45 of 54 counties sampled (Table 2). *Reithrodontomys megalotis* and *Microtus californicus* specimens have demonstrated evidence of infection with Sin Nombre-like hantaviruses (El Moro Canyon and Isla Vista, respectively), but these strain variants have not been shown to be pathogenic to humans. Seroreactivity has been occasionally identified in *Neotoma*, *Chaetodipus*, and *Spermophilus* rodents in California and elsewhere; however, it is believed that these species are incidentally infected with SNV and are not competent reservoirs or vectors.

Table 1. Serum antibodies to hantavirus (Sin Nombre) detected in California rodents, 1975-2006.

		2006			1975-2006		
Species	Common name	No. collected	No. reactive	Percent	No. collected	No. reactive	Percent
FAMILY MURIDAE							
SUBFAMILY SIGMODONTINAE							
Neotoma fuscipes	dusky-footed woodrat	18	0	0.0	912	10	1.1
Neotoma lepida	desert woodrat	11	1	9.1	674	22	3.3
Neotoma sp.	other and unspecified *Neotoma*				121	2	1.7
Onychomys torridus	southern grasshopper mouse				5	0	0.0
Peromyscus boylii	brush mouse	523	27	5.2	2522	106	4.2
Peromyscus californicus	parasitic mouse	89	1	1.1	1992	38	1.9
Peromyscus crinitus	canyon mouse	10	0	0.0	340	13	3.8
Peromyscus eremicus	cactus mouse	371	2	0.5	2137	84	3.9
Peromyscus maniculatus	deer mouse	1245	194	15.6	10367	1367	13.2
Peromyscus truei	piñon mouse	35	0	0.0	793	26	3.3
Peromyscus sp.	unspecified *Peromyscus*	1	0	0.0	160	15	9.4
Reithrodontomys megalotis	western harvest mouse	134	6	4.5	883	88	10.0
Sigmodon hispidus	hispid cotton rat				22	0	0.0
SUBFAMILY ARVICOLINAE							
Clethrionomys californicus	California red-backed vole				1	0	0.0
Microtus californicus	California vole	17	0	0.0	268	35	13.1
Microtus spp.	other and unspecified *Microtus*	34	5	14.7	106	11	10.4
SUBFAMILY MURINAE							
Mus musculus	house mouse	1	0	0.0	317	0	0.0
Rattus spp.	Norway rat and black rat				203	0	0.0
FAMILY HETEROMYIDAE							
Chaetodipus spp.	pocket mice				580	3	0.5
Dipodomys spp.	kangaroo rats	1	0	0.0	78	1	1.3
Perognathus parvus	Great Basin pocket mouse	5	0	0.0	27	1	3.7
FAMILY SCIURIDAE							
Ammospermophilus leucurus	white-tailed antelope squirrel				5	0	0.0
Glaucomys sabrinus	northern flying squirrel				1	0	0.0
Sciurus griseus	western gray squirrel				1	0	0.0
Spermophilus spp.	ground squirrels				1227	1	0.1
Tamias spp.	chipmunks	3	0	0.0	288	0	0.0
Tamiasciurus douglasii	Douglas squirrel				8	0	0.0

Source: California Department of Public Health

Table 2. Serum antibodies to hantavirus (Sin Nombre) detected in *Peromyscus maniculatus* in California, 1975-2006.

	2006			1975-2006		
County	No. collected	No. reactive	Percent	No. collected	No. reactive	Percent
Alameda				113	2	1.8
Alpine	7	1	14.3	131	37	28.2
Butte				115	14	12.2
Calaveras				48	10	20.8
Colusa				23	9	39.1
Contra Costa	1	0	0.0	54	2	3.7
Del Norte				49	1	2.0
El Dorado	61	5	8.2	553	176	31.8
Fresno	8	0	0.0	530	75	14.2
Glenn				4	0	0.0
Humboldt				55	5	9.1
Imperial				6	1	16.7
Inyo				103	10	9.7
Kern				129	10	7.8
Lake				22	1	4.5
Lassen	121	16	13.2	745	123	16.5
Los Angeles	5	1	20.0	416	23	5.5
Madera				62	8	12.9
Marin	18	1	5.6	123	4	3.3
Mariposa				46	7	15.2
Mendocino				38	4	10.5
Merced				68	4	5.9
Modoc				84	10	11.9
Mono	322	103	32.0	616	163	26.5
Monterey				145	16	11.0
Napa				66	8	12.1
Nevada				173	59	34.1
Orange	283	17	6.0	1178	66	5.6
Placer				32	2	6.3
Plumas				143	33	23.1
Riverside	217	38	17.5	1742	206	11.8
Sacramento				36	0	0.0
San Bernardino	128	4	3.1	572	44	7.7
San Diego	56	5	8.9	548	34	6.2
San Francisco				30	0	0.0
San Joaquin				11	1	9.1
San Luis Obispo				107	11	10.3
San Mateo				200	15	7.5
Santa Barbara				325	88	27.1
Santa Clara	2	0	0.0	45	0	0.0
Shasta				35	4	11.4
Sierra	16	3	18.8	101	18	17.8
Siskiyou				122	12	9.8
Solano				3	0	0.0
Sonoma				133	1	0.8
Stanislaus				15	0	0.0
Sutter				7	0	0.0
Tehama				35	5	14.3
Trinity				24	8	33.3
Tulare				20	2	10.0
Tuolumne				130	23	17.7
Ventura				196	12	6.1
Yolo				25	0	0.0
Yuba				31	0	0.0
Douglas, NV				5	1	20.0
Total	**1245**	**194**	**15.6**	**10368**	**1368**	**13.2**

Source: California Department of Public Health

Flea-borne Disease Surveillance

Plague

The California Department of Public Health (CDPH) collaborates with local, state, and federal agencies to conduct a statewide plague surveillance program. The CDPH Vector-Borne Disease Section (VBDS) collects, collates, and analyzes information on suspect and confirmed plague activity among humans, domestic pets, and wild animals throughout California. This report summarizes plague activity in California for 2006.

Human surveillance

Two human cases of plague were confirmed among California residents in 2006.

Los Angeles County, April 2006

A 27-year-old Hispanic woman developed fever, malaise, and a swollen axillary lymph node in April. She was hospitalized, treated with antimicrobials, and recovered within a week of presentation. Blood culture obtained at admission grew organisms confirmed as *Yersinia pestis* by the Los Angeles County Department of Public Health (LACDPH) laboratory. The case-patient was a homemaker with no history of recent travel or contact with animals. Staff of the LACDPH Vector Management Program and VBDS observed no rodents at the case-patient's residence.

Additional questioning revealed that the case-patient had prepared for family consumption a rabbit that the husband had collected in the Mojave Desert in eastern Kern County. CDPH received reports from other agencies of an apparent die-off of rabbits in the area. In early May, staff of VBDS, LACDPH Vector Management, and Kern County Environmental Health investigated several sites in the area. Few live rabbits and several dessicated rabbit carcasses were observed. Rodent surveillance conducted over 120 trap-nights at three locations yielded 30 rodents. One of two rabbit carcasses collected was positive for *Y. pestis* by direct fluorescent antibody (DFA) and serum antibodies to *Y. pestis* were detected in 5 of 20 deer mice.

Inyo County, June 2006

A 79-year-old female presented to a hospital in Mono County in June with chief complaints of confusion, loss of appetite, and back pain. On physical exam, the patient was noted to be febrile, pale, dehydrated, and able to respond only to simple, short questions. No lymphadenopathy was evident. Initial hematology was significant for leukocytosis and mild thrombocytopenia. Patchy infiltrates were noted in the left lower lobe on thoracic roentgenography. The patient was provided fluids, supplemental oxygen, and intravenous ceftriaxone but became obtunded with impaired pulmonary and renal function. She was air-lifted to a hospital in San Diego on Day Three of hospitalization. The patient was treated with gentamicin, doxycycline, and other empiric broad-spectrum antibiotics. The patient recovered slowly from her acute illness, but died later in 2006.

Blood cultures drawn at admission grew chains of gram-positive, bipolar-staining rods. Biochemical testing suggested *Y. pestis*; anti-F1 antigen monoclonal direct fluorescent antibody test and polymerase chain reaction (PCR) performed by the San Diego County

Public Health Laboratory confirmed the identification. Despite development of pneumonia-like symptoms, sputum cultures were repeatedly negative throughout her hospitalization.

The patient had no reported travel outside the Mono and Inyo Counties area in the weeks preceding her illness. Staff of Mono County Environmental Health conducted a preliminary inspection of the patient's residence in late June. Ground squirrel burrows, mostly abandoned, were observed around the house and rodent feces were observed in the kitchen. In early July, VBDS staff joined Mono County Departments of Health and Environmental Health for further evaluation and rodent surveillance. Rodent feces were observed in all rooms of the house and two dessicated deer mice were found. Antibodies to *Y. pestis* were detected by the University of California, Davis, Plague Laboratory in blood specimens from two ground squirrels (*Spermophilus beecheyi*) collected on the case-patient's property. Antibodies to *Y. pestis* were not detected in specimens from 32 other rodents, representing eight species. Antibodies to *Y. pestis* were also detected in serum from the case-patient's dog. A decomposed cottontail rabbit leg and a fresh ground squirrel carcass found less than 10 meters and approximately 0.6 kilometers from the case-patient's house, respectively, tested inconclusive for *Y. pestis* by DFA but were positive by PCR. *Yersinia pestis* was detected by PCR in three of four pools of *Oropsylla montana* fleas (from *S. beecheyi*) and one of two pools of *Oropsylla bacchi* fleas (from *Ammospermophilus leucurus*).

Domestic pets

Four dogs were tested for serum antibodies to *Y. pestis*. One dog from Mono County was observed to have a titer of 1:64. All others tested negative.

Wild animals

Through the statewide plague surveillance program, blood samples were collected from 832 wild carnivores and 188 feral pigs from 34 California counties. Antibodies to *Y. pestis* were detected in 45 (8.6%) of 523 coyotes. Antibodies to *Y. pestis* were also detected in 5 of 28 black bears, 1 of 99 raccoons, 1 of 115 skunks, and 6 of 188 feral pigs. None of 36 feral cats, 38 red foxes, 10 gray foxes, 10 mountain lions, 9 bobcats, and 8 opossums was seropositive. Seropositive carnivores or feral pigs were identified in seven counties: El Dorado, Kern, Lassen, Mariposa, Modoc, Plumas, and Sierra Counties.

Twenty-three of 26 (88%) coyotes sampled from the Sierra Valley region of Plumas and Sierra Counties tested serologically positive in April and May, indicating winter and spring plague activity among rodent prey in this region. Two seropositive rodents were detected in the vicinity of Yuba Pass, west of Sierra Valley, later in the summer.

Blood samples were tested from 654 wild rodents collected in 20 California counties through the VBDS cooperative program. Antibodies to *Y. pestis* were detected in 13 of 297 California ground squirrels, 1 of 2 pine squirrels, 1 of 3 long-eared chipmunks, 1 of 36 lodgepole chipmunks, and 5 of 87 deer mice. Seropositive rodents were identified from five counties: El Dorado, Inyo, Kern, Mono, and Sierra. Rodent plague surveillance conducted independently by Los Angeles County Department of Public Health (LACDPH), Orange County Vector Control District, and San Diego County Health Department identifed one, zero, and six seropositive California ground squirrels, respectively.

Twenty-seven wild rodents, 12 rabbits (cottontail, brush, and jackrabbits), and 17 flea pools from rodents collected in Alpine, Contra Costa, El Dorado, Inyo, Kern, Los Angeles, Mono, Monterey, Nevada, Placer, San Luis Obispo, Shasta, and Tulare Counties were submitted to the CDPH Microbial Disease Laboratory for bacteriologic testing. *Yersinia pestis* was detected by DFA and culture in one cottontail rabbit and two California ground squirrels, and by PCR in one ground squirrel flea pool from Kern County. *Yersinia pestis* was detected by PCR in one cottontail rabbit and one California ground squirrel from Mono County. Five flea pools from Mono County, three from California ground squirrels and two from Antelope ground squirrels, were positive for *Y. pestis* by PCR.

Murine typhus

Sixteen cases of murine typhus were reported in 2006. Case-patients were residents of Los Angeles (14), Monterey, and Orange Counties. Case-patients' ages ranged from 4 to 75 years and eight (50%) were male. Eleven cases (69%) had onset between July and October. Ten illnesses required hospitalization.

Six cases of typhus occurred in residents of southern coastal Los Angeles County near and within the city of Long Beach, an area not previously recognized as endemic for typhus. An additional case occurred in Orange County along the border with Long Beach. VBDS, the City of Long Beach Department of Health and Human Services (HHS), and Orange County Vector Control District interviewed patients and conducted field investigations to determine potential exposure routes. Rodent and marsupial surveillance were conducted around case-patient homes. Eleven captured opossums had an average of 110 fleas per animal (range, 10 to >220) representing four species: *Ctenocephalides felis* (742), *Pulex irritans* (105), *Oropsylla montana* (2), and *Echidnophaga gallinacea* (1). Blood, tissue, and fleas collected from 11 opossums and 20 roof rats were submitted to the Viral and Rickettsial Zoonosis Branch, U.S. Centers for Disease Control and Prevention, for testing. Eight of 35 fleas from three opossums were positive for a *Rickettsia felis*-like organism by nested PCR assays.

CDPH, LACDPH Vector Management Program, and City of Long Beach HHS collaborated to develop a murine typhus prevention program. Neighborhoods where typhus case-patients resided were canvassed with flyers on murine typhus, flea control, and animal control options. A letter sent to local veterinarians apprised them of the cases and recommended that their clients use appropriate flea control measures on their pets, and in their homes and yards.

Table 3. Mammals tested for plague in California, 2006. (All specimens are sera except where otherwise indicated.)

County Location[1]	**No. rodents tested**	**No. carnivores tested**	**Positive specimens**		
			Species	**Result**	**Month**
Alameda	21	21			
Alpine	34				
Butte		9			
Contra Costa	1	3			
El Dorado	28	5			
LTBMU, Tallac Historic Site			CA G Sq	1:128	October
South Lake Tahoe			Coyote	1:2048	May
South Lake Tahoe			Coyote	1:256	June
Fresno	52	21			
Imperial		19			
Inyo	76				
Baker Creek CG			CA G Sq	1:1024	June
Baker Creek CG			CA G Sq	1:1024	June
Baker Creek CG			CA G Sq	1:256	June
Baker Creek CG			CA G Sq	1:1024	July
Baker Creek CG			CA G Sq	1:512	July
Baker Creek CG			CA G Sq	1:128	September
Diaz Lake CG			CA G Sq	1:512	August
Taboose Creek CG			CA G Sq	1:128	September
Taboose Creek CG			CA G Sq	1:32	September
Taboose Creek CG			CA G Sq	1:4096	September
Kern	55	239			
Arvin, 5SE			Coyote	1:64	November
Bakersfield, 15E			Coyote	1:128	May
Bakersfield, 15N			Coyote	1:32	May
Bakersfield, 1S			Coyote	1:256	September
Cantil, 4W, Hwy14, Jawbone Canyon Rd., 2W			Cottontail, A	POS[2]	May
Cantil, 4W, Hwy14, Jawbone Canyon Rd., 2W			Deer Mouse	1:2048	May
Cantil, 4W, Hwy14, Jawbone Canyon Rd., 2W			Deer Mouse	1:512	May
Cantil, 5W, Lone Tree Canyon Rd., 2W			Deer Mouse	1:1024	May
Cantil, 5W, Lone Tree Canyon Rd., 2W			Deer Mouse	1:256	May
Cantil, 5W, Lone Tree Canyon Rd., 2W			Deer Mouse	1:512	May
Frazier Park			Black Bear	1:1024	August
Frazier Park			Coyote	1:512	January
Frazier Park, 7W			Coyote	1:1024	January
Keene			CA G Sq	POS	May
Keene			CA G Sq	POS	May
Lebec, 5E			Feral Pig	1:64	July
Maricopa, 5E			Coyote	1:32	January
Metler, 15SE			Feral Pig	1:128	June
Metler, 15SE			Feral Pig	1:32	June
Metler, 15SE			Feral Pig	1:64	June
Pine Mountain Club			Raccoon	1:512	August
Wheeler Ridge, 2.5W			Coyote	1:128	June
Wheeler Ridge, 3W			Coyote	1:256	June
Woody, 10SW			Coyote	1:32	November
Kings		1			
Lassen	10	5			
Susanville			Skunk	1:64	July
Los Angeles	293	32			
Angeles NF, Big Pine Organizational Camp			CA G Sq	1:1024	September
Madera		8			

Source: California Department of Public Health

Table 3. continued. Mammals tested for plague in California, 2006.

County Location[1]	No. rodents tested	No. carnivores tested	Positive specimens		
			Species	Result	Month
Mariposa		41			
Catheys Valley, 3SE			Feral Pig	1:32	January
Catheys Valley, 3SE			Feral Pig	1:32	January
Yosemite NP, Yosemite Valley			Black Bear	1:64	June
Yosemite NP, Yosemite Valley			Black Bear	1:512	August
Yosemite NP, Yosemite Valley			Black Bear	1:32	August
Yosemity NP			Black Bear	1:64	August
Mendocino		16			
Merced		2			
Modoc		20			
Alturas, 10W			Coyote	1:256	May
Alturas, 10W			Coyote	1:512	May
Alturas, 1N			Coyote	1:1024	May
Alturas, 1N			Coyote	1:256	May
Alturas, 4W			Coyote	1:256	June
Alturas, 5SE			Coyote	1:128	May
Alturas, 6S			Coyote	1:1024	May
Eagleville, 6E			Coyote	1:128	June
Likely, 5SW			Coyote	1:128	April
Mono	81				
Inyo NF, Sherwin Creek CG			Chipmunk, LE	1:2048	May
Swall Meadows			CA G Sq	POS[2]	July
Swall Meadows			CA G Sq	1:2048	July
Swall Meadows			CA G Sq	1:2048	July
Swall Meadows			Cottontail	POS[2]	July
Swall Meadows			Domestic Dog	1:64	July
Monterey	1	52			
Nevada	3	3			
Orange	235				
Placer	1	34			
Plumas	2	26			
Beckwourth, 4E			Coyote	1:128	April
Beckwourth, 5W			Coyote	1:128	April
Beckwourth, 6NW			Coyote	1:256	May
Beckwourth, 6NW			Coyote	1:256	May
Chilcoot, 4N			Coyote	1:128	May
Vinton, 2N			Coyote	1:256	April
Vinton, 3N			Coyote	1:512	April
Vinton, 3N			Coyote	1:128	April
Vinton, 3N			Coyote	1:128	May
Vinton, 3N			Coyote	1:128	May
Vinton, 3S			Coyote	1:128	April
Vinton, 4N			Coyote	1:64	April
Vinton, 4N			Coyote	1:1024	April
Riverside	125				
San Bernardino	64				
San Diego	185	37			
Palomar Mountain State Park, Cedar Grove Group Camp			CA G Sq	1:512	July
Palomar Mountain State Park, Cedar Grove Group Camp			CA G Sq	1:2048	July
Palomar Mountain State Park, Cedar Grove Group Camp			CA G Sq	1:128	August
Palomar Mountain State Park, Cedar Grove Group Camp			CA G Sq	1:2048	August
Palomar Mountain State Park, Cedar Grove Group Camp			CA G Sq	1:512	September
Palomar Mountain State Park, Cedar Grove Group Camp			CA G Sq	1:2048	September

Source: California Department of Public Health

Table 3. continued. Mammals tested for plague in California, 2006.

County Location[1]	**No. rodents tested**	**No. carnivores tested**	**Positive specimens**		
			Species	**Result**	**Month**
San Joaquin		4			
San Luis Obispo	6	63			
San Mateo	3	15			
Santa Barbara	10	21			
Santa Clara	2	33			
Santa Cruz		2			
Shasta	1				
Sierra	19	14			
Calpine, 7NW			Coyote	1:128	May
Loyalton			Coyote	1:2048	April
Loyalton, 2N			Coyote	1:128	May
Loyalton, 3N			Coyote	1:128	May
Tahoe NF, San Francisco State College Field Station			Chipmunk, LP	1:64	August
Tahoe NF, San Francisco State College Field Station			Pine Squirrel	1:64	August
Sierraville, 4N			Coyote	1:128	April
Sierraville, 4N			Coyote	1:128	April
Sierraville, 4NW			Coyote	1:2048	April
Sierraville, 4NW			Coyote	1:512	April
Sierraville, 6N			Coyote	1:128	April
Sierraville, 7N			Coyote	1:1024	April
Sierraville, 8N			Coyote	1:128	April
Stanislaus	3	21			
Tulare	11				
Tuolumne		6			
Ventura	32	6			
Yuba	12	53			
Total	**1366**	**832**			

1. Mileage and direction from nearest town may be indicated
2. Carcass, tested by culture, PCR, or DFA

Abbreviations

Location
- CG: Campground
- LTBMU: Lake Tahoe Basin Management Unit
- NF: National Forest
- NP: National Park

Species
- CA G Sq: California ground squirrel
- Chipmunk, LE: Least chipmunk
- Chipmunk, LP: Lodgepole chipmunk
- Cottontail, A: Audubon's cottontail

Source: California Department of Public Health

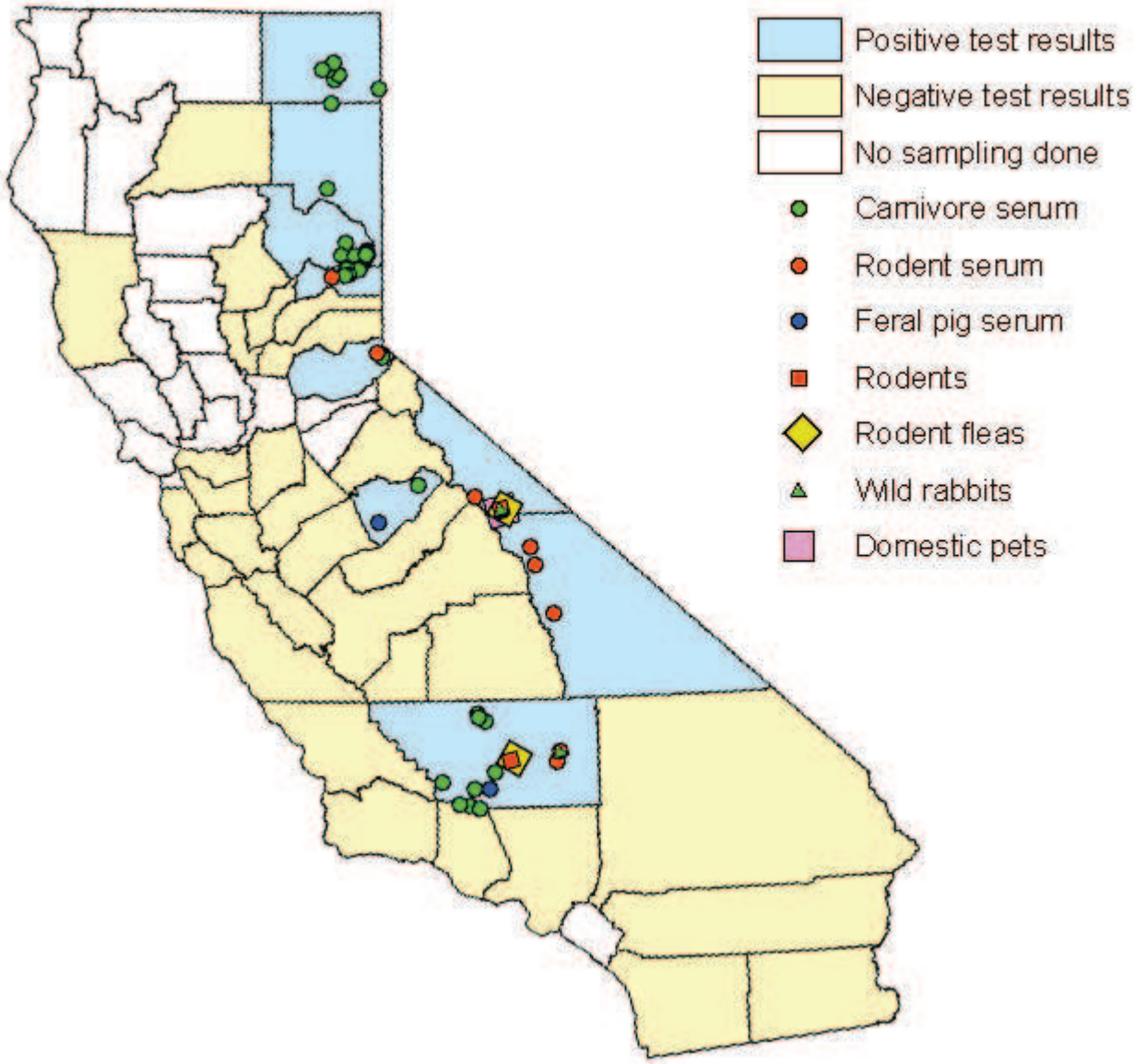


Figure 1. Mammals tested for evidence of *Yersinia pestis*, California, 2006. Icons indicate one or more positive specimens.

Source: California Department of Public Health

Tick-borne Disease Surveillance

Human disease surveillance

Lyme disease

A total of 86 cases of Lyme disease were reported to the California Department of Public Health (CDPH) in 2006. Case-patients were residents of 23 counties (Table 4). Los Angeles County reported the most cases (11). Reported incidence was highest in Inyo County at 5.5 cases per 100,000 residents (Figure 2). Of 38 cases for whom county of likely exposure was reported, 35 (92%) had exposure outside their county of residence; 31 (89%) of these reported exposure outside California. The most frequently reported locations of likely exposure were Connecticut, Massachusetts, New York, and Sweden (four cases each).

The median age of reported Lyme disease cases was 38 years (range, 2 to 85 years) and 48 (56%) were male. Of 74 cases for which race was reported, 72 (97%) were white and two were Asian. Erythema migrans (EM) was diagnosed in 53 (62%) cases. Of 47 cases with EM for which date of illness onset was reported, 38 (81%) occurred between May and August.

Tick-borne relapsing fever

Five cases of tick-borne relapsing fever (TBRF) were reported to CDPH in 2006. Case-patients were residents of four counties (El Dorado, Los Angeles [2], Mono, Yolo) and ranged from 4 to 63 years old. Three case-patients were likely infected in the greater Lake Tahoe area (El Dorado County), one in Mono County, and one in Fresno County. All cases had onsets of illness between May and July.

One of the Los Angeles County cases was a 59-year-old male who developed recurrent fevers, myalgia, and headaches in July, three weeks after visiting a family-owned cabin near Huntington Lake in Fresno County. *Borrelia* spirochetes were identified on blood smear. The case-patient stated that TBRF was diagnosed in 2005 and 2001 in two other family members who had visited the cabin. In August 2006, CDPH inspected the cabin and conducted surveillance for rodents and ticks. Two engorged female *Ornithodoros hermsi* ticks were collected in the bedroom where all three family members had slept. An *O. hermsi* nymph was extracted from a rodent nest discovered in a disused fireplace in the bedroom. The National Institutes of Health, Rocky Mountain Laboratories detected *Borrelia hermsii* by polymerase chain reaction (PCR) in a pooled sample of the two female ticks. Of 49 serum specimens from sylvatic rodents collected in the area and tested for antibodies to *B. hermsii*, seven of 24 *Tamias speciosus* and one of 18 *Peromyscus maniculatus* were positive.

Tularemia

Five cases of tularemia were reported to CDPH in 2006, two of which were possibly acquired via tick bite.

In late May, a six-year-old female resident of Marin County presented with fever (104 ^{o}F) and an enlarged cervical lymph node. The patient recovered following six days in hospital and treatment with moxifloxacin. Culture of a fine needle aspirate from the lymph node was positive by PCR for *Francisella tularensis*, Type B. The patient had camped in San Mateo County about three weeks prior to onset. In July, CDPH and San Mateo County Mosquito Abatement District (MAD) conducted surveillance at the campground site and collected 43 *D. occidentalis*

and 175 *D. variabilis*. One of six pools of *D. occidentalis* and one of 17 pools of *D. variabilis* tested positive by PCR for *F. tularenisis*, Type B, by the Division of Vector-Borne Infectious Diseases (DVBID), Centers for Disease Control and Prevention (CDC). The San Mateo County campsite was very near or identical to the likely site of exposure for another pediatric tularemia case reported in 2004.

In late May, a 48-year-old male resident of Contra Costa County presented with abdominal pain and developed fever and pneumonia. He was hospitalized for three days and released on antibiotics. Blood culture by Kaiser regional laboratory identified an isolate as *F. tularensis*, which was subsequently confirmed by PCR at the CDPH Microbial Diseases Laboratory as *F. tularensis,* Type B. The patient had resided three months at a rural farm and drug rehabilitation center prior to onset of symptoms. The patient had contact with dogs and cats and reported observing ticks during his daily walks. In June, CDPH and Contra Costa County Mosquito and Vector Control District visited the center and collected 52 *D. occidentalis* and 24 *D. variabilis*; no ticks tested for *F. tularensis* by PCR at DVBID were positive.

Anaplasmosis

Two cases of human granulocytic anaplasmosis were reported to CDPH in 2006.

A 39-year-old African-American male resident of Los Angeles County developed fever (104 ^{o}F), headache, myalgia, and malaise in June. The case-patient developed pneumonia following hospitalization and required intubation. He was treated with several broad-spectrum antibiotics and recovered. Serum collected 12 days after onset demonstrated elevated IgM (1:2560) and IgG (1:128) titers to *Anaplasma phagocytophilum*. Convalescent sera collected two weeks later continued to show elevated IgM (1:5120) and IgG (1:2048) titers. The case-patient had traveled to rural areas of western Africa in late May. He reported that he had also visited Solano and Alameda Counties prior to onset, but denied outdoor activities or tick bites while there.

In mid August, a 22-year-old male from Santa Clara County, who was a counselor at a mountain camp in Fresno County, complained of shortness of breath, headache, and abdominal pain. Upon examination, he was found to have a fever and low platelet count. The patient had elevated serum IgM (>1:160) and IgG (1:256) antibodies to *A. phagocytophilum* at the CDPH Viral and Rickettsial Disease Laboratory (VRDL) and was released from the hospital following antibiotic treatment.

Tick surveillance

CDPH and collaborating agencies conducted tick surveillance in 23 counties in 2006. Totals of 2,630 *Ixodes pacificus* (2,385 adults and 245 nymphs), 424 *D. occidentalis*, and 222 *D. variabilis* were collected by flagging vegetation. Of these, 1,434 *I. pacificus* (1,281 adults and 153 nymphs) from 16 counties were tested for *Borrelia burgdorferi* by PCR at the U.S. Army Center for Health Promotion and Preventive Medicine (Table 5). Any ticks initially positive for the genus *Borrelia* were tested by an additional PCR assay using primers specific for *B. burgdorferi*. *Borrelia burgdorferi* was detected in four of 196 *I. pacificus* pools by PCR; positive ticks were collected from three counties: El Dorado, Madera, and Trinity.
Borrelia sp. spirochetes detected in *I. pacificus* tick pools from El Dorado (1), Nevada (1), and

Tuolumne (1) counties did not match the genetic sequence for *B. burgdorferi*. These isolates most closely resembled *B. miyamotoi*, a *Borrelia* species in the TBRF genetic complex that is not known to be pathogenic to humans. To date, *B. miyamotoi* sensu lato has been detected in 12 California counties: Contra Costa, El Dorado, Mendocino, Monterey, Nevada, Placer, Riverside, San Luis Obispo, Shasta, Sonoma, Tuolumne, and Trinity.

A study of the ecology of *I. pacificus* in southern California, initiated in 2001, continued in 2006. CDPH and collaborating agencies monitored tick populations and collected questing ticks from six sites at three different geographic locales (Griffith Park, Santa Monica Mountains, and San Jacinto Mountains). Meteorological factors, including rainfall and humidity, were simultaneously monitored. These data on tick populations, meteorological factors, infection with *B. burgdorferi*, and molecular characterization of *Borrelia* species from ticks will continue to be collected to gain a better understanding of the ecology of *I. pacificus* and *B. burgdorferi* in southern California.

Tick surveillance was conducted in San Mateo County for *Rickettsia rickettsii*, the agent of Rocky Mountain spotted fever. In June, CDPH and San Mateo County MAD personnel collected 141 adult *D. occidentalis* and 53 adult *D. variabilis*. All ticks were tested by PCR for *R. rickettsii* by VRDL (results pending).

Sixty-two adult *Rhipicephalus sanguineus* ticks were collected from a suburban residence in Riverside County and tested for *R. rickettsii* by nested PCR at the CDC. *Rickettsia rickettsii* DNA was detected in one male tick. This represented the first detection of *R. rickettsii* DNA from adult *Rh. sanguineus* ticks in California.

In 2006, staff of VBDS and the CDPH California Epidemiologic Investigation Service (Cal-EIS) conducted two projects that focused on tick exposure and tick-borne disease risk of U.S. Forest Service (USFS) workers. One project evaluated occupational exposure to ixodid ticks among USFS employees; ticks were collected by flagging in nine National Forests and tick exposure history and prevention behaviors among USFS staff were accessed by survey. A second study evaluated ecological and environmental risk factors for TBRF at USFS facilities in California. Additional information on these projects is presented in the U.S. Forest Services Activities section that begins on page 41 of this Report.

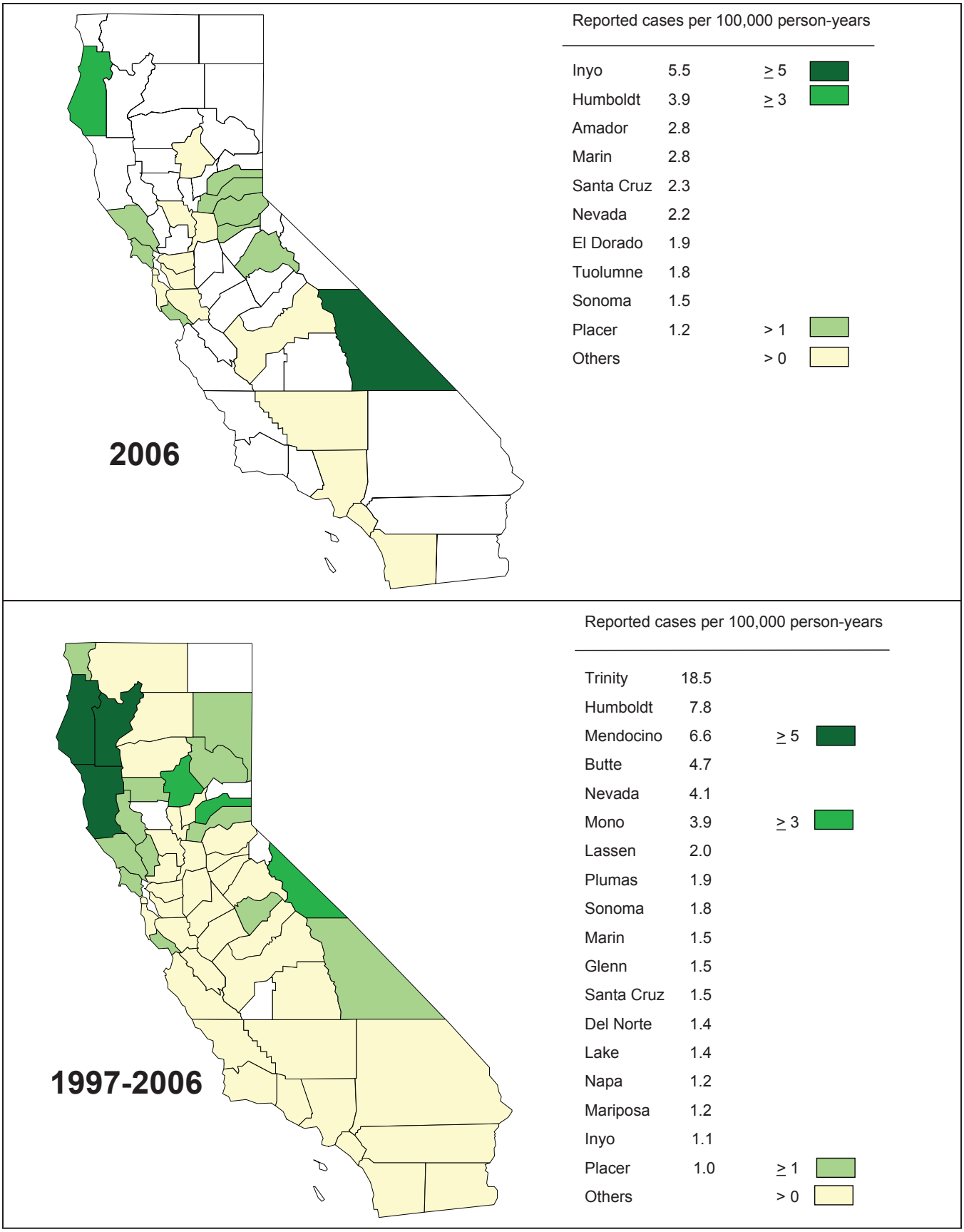


Figure 2. Reported incidence of Lyme disease by county of residence, California, 1997-2006.

Source: California Department of Public Health

Table 4. Reported Lyme disease cases by county of residence, California, 1997-2006.

County	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Incidence per 100,000 person-years
Alameda	3	6	3	4	3	5	1	0	5	3	0.23
Alpine	0	0	0	0	0	0	0	0	0	0	0.00
Amador	0	0	1	0	1	0	0	0	0	1	0.85
Butte	53	13	18	3	1	3	2	2	0	1	4.69
Calaveras	0	0	0	1	0	0	0	0	0	0	0.25
Colusa	0	0	0	0	0	0	0	0	0	0	0.00
Contra Costa	6	2	1	1	5	3	4	0	4	1	0.28
Del Norte	1	0	1	0	0	2	0	0	0	0	1.44
El Dorado	3	2	1	0	0	0	0	3	3	3	0.94
Fresno	0	0	0	1	0	0	0	0	0	1	0.02
Glenn	2	0	1	1	0	0	0	0	0	0	1.50
Humboldt	19	20	14	10	4	4	5	7	11	5	7.80
Imperial	1	0	0	0	0	0	0	0	0	0	0.07
Inyo	0	0	0	0	1	0	0	0	0	1	1.10
Kern	2	2	2	2	0	2	1	0	2	1	0.21
Kings	0	0	0	0	0	0	0	0	0	0	0.00
Lake	1	2	1	0	1	0	1	1	1	0	1.36
Lassen	2	1	2	0	0	2	0	0	0	0	2.04
Los Angeles	6	3	7	2	9	6	7	2	9	11	0.06
Madera	0	0	1	0	0	0	0	0	0	0	0.08
Marin	4	8	4	3	1	4	4	0	1	7	1.53
Mariposa	0	0	0	0	0	1	0	1	0	0	1.17
Mendocino	2	16	8	7	4	11	6	2	0	0	6.56
Merced	2	0	1	1	0	0	0	0	0	0	0.19
Modoc	0	0	0	0	0	0	0	0	0	0	0.00
Mono	0	0	1	0	0	0	3	1	0	0	3.89
Monterey	2	1	2	1	0	5	1	1	0	0	0.32
Napa	3	0	2	2	3	3	0	1	1	0	1.20
Nevada	1	4	5	9	6	3	4	1	3	2	4.12
Orange	0	1	2	3	0	3	2	0	1	2	0.05
Placer	5	4	2	1	4	3	0	2	2	3	1.04
Plumas	0	2	1	0	1	0	0	0	0	0	1.93
Riverside	0	0	0	3	2	1	2	1	4	0	0.08
Sacramento	5	1	1	3	4	1	4	2	6	3	0.24
San Benito	0	0	0	0	1	1	0	0	0	0	0.37
San Bernardino	0	0	1	1	0	0	2	0	0	0	0.02
San Diego	4	0	16	9	3	7	2	4	8	9	0.22
San Francisco	1	7	1	2	3	3	3	1	7	5	0.42
San Joaquin	2	0	0	0	0	0	0	0	0	0	0.04
San Luis Obispo	0	1	1	1	0	0	0	0	1	0	0.16
San Mateo	3	4	4	2	4	4	5	1	4	2	0.46
Santa Barbara	1	3	0	0	1	2	2	2	0	0	0.27
Santa Clara	4	6	2	2	2	6	4	0	2	9	0.22
Santa Cruz	2	2	2	5	9	1	8	3	0	6	1.48
Shasta	0	2	0	0	2	1	0	2	2	0	0.54
Sierra	0	0	0	0	0	0	0	0	0	0	0.00
Siskiyou	1	1	0	0	1	1	0	0	0	0	0.89
Solano	0	0	0	1	1	0	0	0	0	0	0.05
Sonoma	10	15	14	8	6	4	9	2	9	8	1.84
Stanislaus	1	0	0	1	1	0	0	0	1	0	0.09
Sutter	1	0	0	1	1	0	0	0	0	0	0.38
Tehama	1	1	0	2	0	0	0	0	0	0	0.72
Trinity	0	1	13	1	1	1	1	3	3	0	18.46
Tulare	0	1	1	0	2	0	2	0	0	0	0.16
Tuolumne	0	0	0	0	2	1	0	0	1	1	0.91
Ventura	0	2	1	2	2	1	1	2	1	0	0.16
Yolo	0	0	0	0	0	2	0	1	0	1	0.24
Yuba	0	1	1	0	0	0	0	0	0	0	0.33
Total	154	135	139	96	92	97	86	48	94	86	0.30

Source: California Department of Public Health

Table 5. *Ixodes pacificus* ticks tested for evidence of *Borrelia* species, California, 2006.

County	Location	No. ticks tested	No. pools tested	PCR *Borrelia* spp.[a]	PCR *B. burgdorferi*[b]
Butte	Oroville	35	5	0	
Del Norte	Elk Creek Camp	31	4	0	
	Gasonet Flat	7	2	0	
	Gasonet Mountain	1	1	0	
El Dorado	Pony Trailhead	161	18	2	1
	Riverton	79	9	0	
	Dru Barner Campground	9	2	0	
	Barner Park	17	2	0	
	Georgetown Ranger Station	58	7	0	
	Georgetown Ranger Station	4*	1	0	
	Riverston Road	7	2	0	
Humboldt	Eyesee Road	38	5	0	
	Perch Creek Campground	16	2	0	
	Sandy Bar-Friday Ridge Road	1	1	0	
Los Angeles	Griffith Park	206	25	0	
Madera	Chepo Saddle	62	7	2	2
	Batterson Station - Sky Ranch Road	5	2	0	
	Batterson Station - Sky Ranch Road	1*	1	0	
Nevada	Nevada City	52	7	1	0
	Nevada City	13*	1	0	
Placer	Driver's Flat	62	7	0	
Plumas	Mt. Hough Road	22	3	0	
	Slate Creek Road	7	2	0	
Riverside	Thomas Mountain	7	2	0	
	Santa Rosa Plateau	13	6	0	
	Santa Rosa Conservatory	15	6	0	
	Spittler Creek Trail	12	5	0	
	Santa Rosa Mountain	1	1	0	
Santa Barbara	Carpinteria	30	2	0	
	La Patera Ranch	20	2	0	
	Refugio Road	20	2	0	
	Romero Canyon	20	2	0	
	San Antonio Creek Trail	12	2	0	
Santa Cruz	Brayshaw Trail, Pogonip City Park	3	2	0	
	Spring Trail, Pogonip City Park	43	5	0	
Sonoma	Sonoma Development Center	84*	8	0	
Trinity	Salyer-Campbell Ridge Road	16	2	1	1
	Salyer-Campbell Ridge Road	3*	1	0	
Tuolumne	Columbia State Historical Park	1	1	0	
	Columbia State Historical Park	6*	1	0	
	Karen Baker Smith Trail	34*	1	1	0
	Mi Wuk Village	84	13	0	
	Mi Wuk Village	8*	3	0	
Ventura	Arroyo Verde Park	49	7	0	
	Sycamore Canyon	56	6	0	
Total ticks tested		1431	196		
Total pools positive				7	4

* Nymphs

All ticks tested at United States Army Center for Health Promotion and Preventive Medicine - West

[a] PCR primer sets were specific to *Borrelia* genus; PCR products positive for *Borrelia* genus but negative for *B. burgdorferi* were sequenced (partial flagellin gene) and found to be most closely related to *B. miyamotoi*.

[b] PCR primer sets were specific for *B. burgdorferi*.

Source: California Department of Public Health

Mosquito-borne Disease Surveillance

The California Arbovirus Surveillance program is a cooperative effort of the California Department of Health Services (CDPH), the University of California at Davis Center for Vectorborne Diseases (CVEC), the Mosquito and Vector Control Association of California (MVCAC), local mosquito abatement and vector control agencies, county and local public health departments, and physicians and veterinarians throughout California. Additional local, state, and federal agencies collaborated upon, and contributed to, the West Nile virus (WNV) component of the arbovirus surveillance program.

In 2006, the surveillance program elements included:

1. Diagnostic testing of specimens from human patients exhibiting symptoms of encephalitis, aseptic meningitis, acute flaccid paralysis, or with unexplained febrile illness of more than seven days.
2. Diagnostic testing of specimens from horses that exhibited clinical signs of viral neurologic disease compatible with western equine encephalomyelitis (WEE), WNV, and other arboviruses as appropriate.
3. Monitoring and testing of mosquitoes for the presence of St. Louis encephalitis (SLE), WEE, and WNV; testing for other arboviruses, as appropriate.
4. Serological monitoring of sentinel chickens for SLE, WEE, and WNV antibodies.
5. Surveillance and diagnostic testing of tree squirrels and dead birds, especially crows and other birds in the family Corvidae, for infection with WNV.
6. Weekly reporting in the CDPH Arbovirus Surveillance Bulletin of arbovirus test results in California and arbovirus activity throughout the United States.
7. Bi-weekly posting of WNV information, including test results, reports, maps, and public education materials on the California WNV website: www.westnile.ca.gov.
8. Mapping of dead bird reports using the WNV Dynamic Continuous-Area Space-Time model.
9. Data management and reporting through the California Surveillance Gateway, a web application used by local agencies, CDPH, and CVEC.

Human disease surveillance

Serological diagnosis of humans infected with WNV and other arboviruses was performed at the CDPH Viral and Rickettsial Disease Laboratory (VRDL) and 33 local public health laboratories. Local laboratories tested for IgM or IgG antibodies to WNV using an immunofluorescent assay (IFA) and/or an IgM enzyme immunoassay (EIA). Specimens with inconclusive results were forwarded to VRDL for further testing or confirmation with a plaque reduction neutralization test (PRNT). Additional WNV infections were identified through testing performed at blood donation centers.

A total of 292 WNV infections among residents of 36 counties were identified in 2006 (Table 6). Twenty-eight of the 292 WNV infections were detected in blood donors, 14 of whom later developed symptoms consistent with West Nile fever. Of the 278 WNV clinical cases (Figure 3), 190 (68%) were classified as West Nile fever, 83 (30%) were neuroinvasive disease (i.e., encephalitis, meningitis, or acute flaccid paralysis), and 5 (2%) were of unknown clinical presentation. Males represented 179 (64%) of 278 cases. The median age for all cases for

which data were available was 49 years (range, 8 to 86 years). The median ages for West Nile fever and neuroinvasive cases were 47 years (range, 8 to 86 years) and 53 years (range, 14 to 86 years), respectively. The median age of the seven WNV-associated fatalities was 82 years (range, 47 to 86 years).

Equine surveillance

Serum or brain tissue from 622 horses displaying neurological signs were submitted to the California Animal Health & Safety Laboratory (CAHFS) and CVEC for arboviral testing. West Nile virus infection was detected in 58 horses from 23 counties (Table 6, Figure 4), of which 24 (41%) died or were euthanatized. Five horses were currently vaccinated with the WNV vaccine at the time of onset, 2 had not completed the recommended vaccine dosage schedule, 44 were unvaccinated, and vaccination history was unknown for 7.

Adult mosquito surveillance

Fifty-one agencies in 40 counties collected a total of 694,087 mosquitoes (21,711 pools) that were tested by reverse transcriptase-polymerase chain reaction (RT-PCR) for SLE, WEE, and WNV viral RNA (Table 7). Testing was performed at CVEC and nine local mosquito and vector control agencies. An additional 111,942 mosquitoes (3,902 pools) were tested at eight local agencies for only WNV using a commercial rapid assay-RAMP® (Rapid Analyte Measurement Platform, Response Biomedical Corp. Burnaby, British Columbia, Canada).

West Nile virus was detected in 832 mosquito pools from 33 counties (Tables 6, 8-9; Figure 5). In 2006, WNV was first detected from four pools of *Culex tarsalis* collected on April 13 in Riverside County. The last detection of WNV in mosquitoes in 2006 was from a pool of *Cx. quinquefasciatus* collected on December 8 in Los Angeles County. West Nile virus was identified from five *Culex* species (*Cx. erythrothorax*, *Cx. pipiens, Cx. quinquefasciatus*, *Cx. stigmatosoma*, *Cx. tarsalis)*, and three other species (*Aedes melanimon, Anopheles freeborni*, *Culiseta incidens*).

Western equine encephalomyelitis virus was detected in 18 mosquito pools (17 *Cx. tarsalis*, 1 *Cx. quinquefasciatus*) from Kern County (Table 7). The first and last WEE positive pools were collected on July 11 and September 21, respectively. St. Louis encephalitis virus was detected in no mosquito pools in 2006.

Chicken serosurveillance

Fifty-two local mosquito and vector control agencies in 39 counties maintained 245 sentinel chicken flocks (Table 7). Blood samples were collected from chickens every other week and tested for antibodies to flaviviruses (SLE and WNV) and WEE by EIA. Presumptive flavivirus or WEE antibody on EIA was confirmed with an IFA and western immunoblot; specimens with inconclusive results were subjected to PRNT. In areas where SLE has never been documented, after at least two chickens had been confirmed with WNV in 2006, any subsequent detections of flavivirus antibodies in chickens from the same flock were assumed to be WNV and confirmatory testing was not performed.

The VRDL and four local mosquito and vector control agencies tested 33,001 chicken sera for antibodies to SLE, WEE, and West Nile viruses. A total of 640 seroconversions to WNV were detected among 122 flocks from 29 counties (Table 6; Figure 6). The first and last WNV

seroconversions were detected among chickens located in Los Angeles County on May 3 and November 14, respectively. In addition, 13 non-specific flavivirus seroconversions were detected in chickens from five counties: Kings (2), Madera (3), Placer (5), San Bernardino (1), and Stanislaus (2). (These data are not included in Table 7.)

A total of 13 WEE seroconversions were detected among five flocks from two counties: Kern (11) and Riverside (2). The first WEE seroconversion was detected in Riverside County on July 24, and the last seroconversion was detected in Kern County on October 9. No seroconversions to SLE were detected in 2006.

Dead bird and rodent surveillance

Established in 2000 and supported by a grant from the U.S. Centers for Disease Control and Prevention, the WNV dead bird surveillance program is a collaborative program between CDPH and over 130 local agencies. The program relies upon the public to report dead birds to a toll-free "WNV Hotline" or through the WNV website. In 2006, CDPH fielded 53,752 calls to the Dead Bird hotline, with peak activity in July and August at over 9,000 calls each month (Figure 7). A total of 46,345 dead bird reports--39,824 through the hotline and 5,806 through the Website (reporting mechanism not recorded for 715)--from 58 counties were received. Carcasses were tested at CVEC by RT-PCR, at CAHFS by immunohistochemistry (IHC), or at one of 28 local agencies by IHC, RAMP, or VecTest (Medical Analysis Systems Inc., Camarillo, CA). In 2006, of 6,535 carcasses deemed suitable for testing, WNV was detected in 1,446 carcasses from 53 counties: 918 by RT-PCR or IHC, 406 by VecTest, and 122 by RAMP (Tables 6, 10; Figure 7).

In 2006, antibodies to WNV were detected in 32 (23.2%) of 138 tree squirrels reported through the Dead Bird hotline from nine counties. These included 20 fox squirrels (*Sciurus niger*), four western gray squirrels (*S. griseus*), one eastern gray squirrel (*S. carolinensis*), and seven squirrels of undetermined species. In addition, a collaborative study was initiated between CDPH, CVEC, and the Lindsey Wildlife Museum to determine WNV viremia and antibody levels in sick tree squirrels. Virus was detected in blood from 7 of 33 (21.2%) tree squirrels tested by Vero cell plaque assay. Of the 26 tree squirrels that tested negative by plaque assay and were tested by PRNT, 14 had antibody titers > 1:80, suggestive of previous exposure to WNV.

Table 6. West Nile virus infections detected in California, 2006.

County	Humans	Horses	Dead Birds	Mosquito Pools	Sentinel Chickens	Dead Squirrels
Alameda	1	0	41	9	0	2
Alpine	0	0	0	0	0	0
Amador	0	0	2	0	0	0
Butte	34	0	40	1	49	1
Calaveras	0	0	2	2	0	0
Colusa	4	0	9	0	1	0
Contra Costa	8	1	93	18	25	18
Del Norte	0	0	0	0	0	0
El Dorado	2	0	19	2	0	0
Fresno	12	5	75	40	37	0
Glenn	12	0	35	1	10	0
Humboldt	0	0	2	0	0	0
Imperial	1	0	0	14	57	0
Inyo	0	0	8	3	0	0
Kern	51	4	24	230	100	0
Kings	1	0	13	34	25	0
Lake	2	2	8	12	6	0
Lassen	0	7	3	3	0	0
Los Angeles	16	0	98	78	38	1
Madera	0	0	3	4	9	0
Marin	1	1	9	2	2	1
Mariposa	0	0	1	0	0	0
Mendocino	0	2	7	0	0	0
Merced	4	3	41	8	15	0
Modoc	2	2	2	0	0	0
Mono	1	0	1	0	0	0
Monterey	0	0	5	0	0	0
Napa	1	0	8	0	0	0
Nevada	1	0	4	0	0	0
Orange	7	0	49	14	0	0
Placer	8	1	13	23	11	0
Plumas	0	0	0	0	0	0
Riverside	4	0	3	31	27	0
Sacramento	16	1	89	34	13	0
San Benito	0	0	1	0	0	0
San Bernardino	3	0	33	25	26	3
San Diego	1	3	26	0	0	0
San Francisco	0	0	3	0	0	0
San Joaquin	8	2	47	40	19	0
San Luis Obispo	1	5	14	0	0	0
San Mateo	0	0	7	0	0	2
Santa Barbara	0	2	19	1	0	0
Santa Clara	5	1	224	8	1	2
Santa Cruz	0	0	7	0	0	0
Shasta	4	4	89	7	4	2
Sierra	0	0	0	0	0	0
Siskiyou	0	0	1	0	0	0
Solano	8	0	21	1	22	0
Sonoma	0	1	23	1	1	0
Stanislaus	12	3	77	51	45	0
Sutter	12	1	2	55	36	0
Tehama	6	2	12	0	3	0
Trinity	0	0	1	0	0	0
Tulare	6	3	14	8	22	0
Tuolumne	0	0	1	0	0	0
Ventura	3	0	62	2	1	0
Yolo	27	0	54	64	26	0
Yuba	7	2	1	6	9	0
State Totals	**292**	**58**	**1,446**	**832**	**640**	**32**

Source: California Department of Public Health

Table 7. Mosquitoes and sentinel chickens tested for St. Louis encephalitis (SLE)[a], western equine encephalomyelitis (WEE), and West Nile virus (WNV), California, 2006.

County	No. mosquitoes tested[b]	No. mosquito pools tested	WNV + pools	WEE + pools	No. flocks	No. chickens	No. sera tested[c]	WNV + sera	WEE + sera
Alameda	14,241	402	9	0	3	21	307	0	0
Amador	103	10	0	0	0	0	0	0	0
Butte	1,223	31	1	0	7	77	1,056	49	0
Calaveras	187	7	1	0	1	10	128	0	0
Colusa	0				1	10	141	1	0
Contra Costa	24,220	520	11	0	5	50	763	25	0
El Dorado	516	12	2	0	0				
Fresno	18,679	504	40	0	10	100	1,392	37	0
Glenn	1,700	34	1	0	1	13	178	10	0
Imperial	14,126	313	14	0	7	70	861	57	0
Inyo	3,751	75	3	0	0				
Kern	79,954	1,964	230	18	14	140	2,020	100	11
Kings	15,046	418	34	0	4	40	464	25	0
Lake	14,186	351	12	0	2	20	305	6	0
Lassen	513	13	3	0	0				
Los Angeles	72,992	2,159	78	0	49	310	5,371	38	0
Madera	2,326	49	4	0	2	20	200	9	0
Marin	244	11	2	0	2	20	278	2	0
Merced	15,850	515	8	0	8	48	698	15	0
Monterey	0				2	20	330	0	0
Napa	0				3	30	420	0	0
Nevada	27	2	0	0	2	19	323	0	0
Orange	36,283	1,040	14	0	1	10	170	0	0
Placer	13,757	468	23	0	6	36	546	11	0
Riverside	139,391	3,597	31	0	21	216	3,388	27	2
Sacramento	47,685	2,640	34	0	5	50	924	13	0
San Bernardino	17,805	534	14	0	17	128	2,477	26	0
San Diego	5,022	110	0	0	4	40	647	0	0
San Francisco	20	1	0	0	0				
San Joaquin	1,085	29	6	0	5	50	637	19	0
San Luis Obispo	590	12	0	0	0				
San Mateo	4,285	103	0	0	2	20	289	0	0
Santa Barbara	15,229	352	1	0	5	53	806	0	0
Santa Clara	0				5	50	655	1	0
Santa Cruz	85	6	0	0	2	20	341	0	0
Shasta	3,751	101	7	0	7	75	910	4	0
Solano	2,450	127	1	0	3	36	451	22	0
Sonoma	159	4	1	0	4	40	519	1	0
Stanislaus	47,335	1,565	50	0	9	100	1,373	45	0
Sutter	20,380	459	55	0	5	50	562	36	0
Tehama	0				3	30	305	3	0
Tulare	5,381	142	8	0	6	60	812	22	0
Ventura	1,597	49	2	0	5	45	748	1	0
Yolo	51,013	2,958	64	0	5	50	947	26	0
Yuba	900	24	6	0	2	20	259	9	0
Total	**694,087**	**21,711**	**770**	**18**	**245**	**2,197**	**33,001**	**640**	**13**

[a]No mosquito pools or sentinel chickens were positive for SLE in 2006

[b]Tested by University of California at Davis Center for Vectorborne Diseases or local mosquito/vector control agencies. Does not include mosquitoes tested by RAMP at local agencies.

[c]Tested by California Department of Public Health Viral and Rickettsial Disease Laboratory or local mosquito/vector control agencies.

Source: California Department of Public Health

Table 8. Mosquito pools (*Culex* spp.) tested[a] for West Nile virus (WNV), California, 2006.

	Cx. erythrothorax		*Cx. pipiens*		*Cx. quinquefasciatus*		*Cx. stigmatosoma*		*Cx. tarsalis*		Other *Culex* spp.[b]	
County	pools	WNV +	pools	WNV +	pools	WNV +	pools	WNV +	pools	WNV +	pools	WNV +
Alameda	84	0	213	7	0		0		102	2	1	0
Amador	0		0		0		0		10	0	0	
Butte	0		3	0	0		0		22	1	0	
Calaveras	0		7	0	0		3	0	17	2	0	
Contra Costa	89	0	160	7	0		0		573	11	0	
El Dorado	0		0		0		0		4	1	0	
Fresno	16	0	0		260	29	6	2	200	9	1	0
Glenn	0		0		0		0		30	1	0	
Imperial	26	0	1	0	6	0	0		266	14	6	0
Inyo	0		0		0		0		75	3	0	
Kern	111	3	0		764	111	0		838	114	0	
Kings	13	0	0		155	11	0		250	23	0	
Lake	15	0	0		0		20	2	299	10	0	
Lassen	0		0		0		0		13	3	0	
Los Angeles	23	0	0		1,813	78	92	0	208	0	14	0
Madera	1	0	41	4	1	0	0		6	0	0	
Marin	5	0	56	0	0		3	0	48	2	0	
Merced	8	0	187	3	0		0		309	5	1	0
Napa	0		2	0	0		0		8	0	0	
Nevada	1	0	0		0		0		1	0	0	
Orange	76	0	0		851	13	33	1	53	0	0	
Placer	7	0	139	6	0		8	0	197	16	8	0
Riverside	364	3	1	0	1,107	3	22	0	2,018	25	38	0
Sacramento	89	0	1,210	9	0		42	0	1,005	25	1	0
San Bernardino	154	0	0		890	12	49	0	136	13	0	
San Diego	32	0	0		28	0	2	0	47	0	0	
San Francisco	0		0		0		0		1	0	0	
San Joaquin	1	0	613	18	0		0		1,050	22	0	
San Luis Obispo	12	0	0		0		0		0		0	
San Mateo	24	0	72	0	0		0		5	0	0	
Santa Barbara	158	0	0		36	0	13	0	102	1	1	0
Santa Clara	0		99	7	0		0		68	1	0	
Santa Cruz	0		4	0	0		0		2	0	0	
Shasta	1	0	61	3	0		3	0	25	4	9	0
Solano	0		46	0	0		0		75	1	0	
Sonoma	1	0	84	0	0		12	0	95	1	0	
Stanislaus	13	0	828	38	1	0	10	0	819	13	2	0
Sutter	0		13	0	0		0		423	55	0	
Tulare	1	0	0		98	8	1	0	42	0	0	
Ventura	16	1	2	0	8	1	1	0	16	0	2	0
Yolo	0		1,131	17	0		109	1	1,630	46	0	
Yuba	0		1	0	0		0		23	6	0	
Total	**1,341**	**7**	**4,974**	**119**	**6,018**	**266**	**429**	**6**	**11,111**	**430**	**84**	**0**

[a] Includes pools tested by reverse-transcriptase polymerase chain reaction and additional pools tested by commercial antigen test (RAMP®)

[b] Includes *Cx. erraticus*, *Cx. restuans*, *Cx. territans*, *Cx. thriambus*, and unidentified *Culex*

Source: California Department of Public Health

Table 9. Mosquito pools (*Aedes* spp., *Anopheles* spp., *Coquillettidia perturbans*, *Culiseta* spp, *Psorophora signipennis*) tested[a] for West Nile virus, California, 2006.

Mosquito Species	*Ae dorsalis*	*Ae melanimon*	*Ae nigromaculis*	*Ae squamiger*	*Ae sierrensis*	*Ae vexans*	*Ae washinoi*	Other *Aedes*	*Aedes* spp. Subtotal	*An franciscanus*	*An freeborni*	*An hermsi*	*Anopheles* spp. Subtotal	*Coquillettida perturbans*	*Cs incidens*	*Cs inornata*	*Cs particeps*	*Ps signipennis*	unknown	Other spp. Subtotal
County																				
Alameda	0	0	0	0	0	0	0	0	0	1	1	0	2	0	0	0	0	0	0	0
Butte	0	5	0	0	0	0	0	0	5	0	0	0	0	0	1	0	0	0	0	1
Contra Costa	0	35	0	0	0	27	0	0	62	0	0	0	0	0	0	0	0	0	0	0
El Dorado	0	0	0	0	0	0	0	2	2	0	0	0	0	0	6[b]	0	0	0	0	6
Fresno	0	11	0	0	1	1	0	0	13	0	0	0	0	0	7	0	1	0	0	8
Glenn	0	1	0	0	0	0	0	0	1	0	3	0	3	0	0	0	0	0	0	0
Imperial	1	0	0	0	0	5	0	0	6	1	0	0	1	0	0	1	0	0	0	1
Kern	0	238[c]	0	0	0	0	0	0	238	0	0	0	0	0	2	11	0	0	0	13
Lake	0	0	0	0	15	0	0	0	15	0	0	0	0	2	0	0	0	0	0	2
Los Angeles	0	0	0	0	0	0	0	0	0	2	0	9	11	0	97	1	0	0	0	98
Marin	27	0	0	0	0	0	2	0	29	0	0	0	0	0	0	0	0	0	0	0
Merced	0	7	0	0	0	0	0	0	7	0	0	0	0	0	0	3	0	0	0	3
Napa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Orange	0	0	0	0	0	0	0	0	0	0	0	27	27	0	0	0	0	0	0	0
Placer	0	23	1	0	0	2	0	3	29	0	75[b]	0	75	1	3	1	0	0	0	5
Riverside	0	0	0	0	0	12	0	0	12	0	0	31	31	0	0	4	0	0	0	4
Sacramento	0	135	4	0	12	72	18	1	242	0	0	0	0	0	17	5	0	0	29	51
San Bernardino	0	0	0	0	1	10	0	0	11	5	0	4	9	0	27	5	0	2	0	34
San Diego	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
San Joaquin	2	215	0	0	3	136	3	0	359	0	0	0	0	0	1	0	0	0	0	1
San Mateo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2
Santa Barbara	0	0	0	0	0	0	12	0	12	7	0	9	16	0	7	0	7	0	0	14
Santa Clara	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Shasta	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	2
Solano	0	6	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
Sonoma	1	0	0	0	6	0	7	0	14	0	0	0	0	0	2	0	2	0	0	4
Stanislaus	0	26	0	0	0	0	0	0	26	0	0	0	0	0	4	15	0	0	6	25
Sutter	0	16	0	0	0	0	0	0	16	0	7	0	7	0	0	0	0	0	0	0
Ventura	0	0	0	0	1	0	1	0	2	0	0	0	0	0	1	0	1	0	0	2
Yolo	0	56	4	0	4	4	3	2	73	0	1	0	1	0	4	3	0	0	7	14
Total	31	774	9	1	43	269	46	8	**1,181**	16	87	80	**183**	4	180	50	14	2	42	**292**

[a] Includes pools tested by reverse-transcriptase polymerase chain reaction and additional pools tested by commercial antigen test (RAMP®)

[b] One pool positive for WNV

[c] Two pools positive for WNV

Source: California Department of Public Health

Table 10. Dead birds and dead tree squirrels reported, tested[a], and positive for West Nile virus, California, 2006.

	Corvids[b]			Non-Corvids			Tree Squirrels[c]		
County	**Reported**	**Tested**	**Positive**	**Reported**	**Tested**	**Positive**	**Reported**	**Tested**	**Positive**
Alameda	379	73	27	1,297	194	14	24	11	2
Alpine	1	1	0	5	1	0	0		
Amador	19	3	1	162	25	1	0		
Butte	388	55	35	465	53	5	13	3	1
Calaveras	31	2	1	234	34	1	1	0	
Colusa	27	9	9	23	5	0	0		
Contra Costa	866	138	74	2,619	249	19	83	40	18
Del Norte	2	1	0	18	6	0	0		
El Dorado	178	27	12	599	107	7	8	0	
Fresno	914	111	49	1,988	213	26	8	2	0
Glenn	106	43	34	67	28	1	0		
Humboldt	37	7	0	102	32	2	0		
Imperial	5	0		32	4	0	0		
Inyo	29	8	7	77	17	1	0		
Kern	148	23	14	782	95	10	1	0	
Kings	105	17	9	231	33	4	2	0	
Lake	93	14	8	188	19	0	1	0	
Lassen	14	1	0	48	11	3	0		
Los Angeles	768	197	62	1,772	451	36	18	8	1
Madera	65	10	2	177	41	1	0		
Marin	340	27	8	515	17	1	14	2	1
Mariposa	6	0		69	12	1	0		
Mendocino	56	16	5	130	28	2	1	1	0
Merced	284	47	36	396	40	5	0		
Modoc	3	2	1	24	6	1	0		
Mono	10	1	1	54	4	0	0		
Monterey	131	17	1	349	71	4	1	1	0
Napa	86	17	8	154	15	0	5	1	0
Nevada	44	4	1	308	55	3	10	2	0
Orange	309	104	34	762	144	15	0		
Placer	199	18	6	1,226	99	7	14	4	0
Plumas	17	2	0	51	10	0	1	0	
Riverside	156	17	1	740	95	2	2	0	
Sacramento	1,151	137	63	3,678	287	26	33	5	0
San Benito	17	5	1	78	16	0	0		
San Bernardino	345	47	20	961	143	13	29	5	3
San Diego	481	216	14	496	175	12	0		
San Francisco	56	7	0	242	42	3	0		
San Joaquin	910	64	41	1,121	69	6	2	0	
San Luis Obispo	92	16	8	422	79	6	0		
San Mateo	184	36	1	816	122	6	55	29	2
Santa Barbara	170	27	15	318	55	4	1	0	
Santa Clara	1,261	350	215	2,043	69	9	46	15	2
Santa Cruz	66	8	1	345	69	6	2	1	0
Shasta	246	107	86	344	47	3	5	4	2
Sierra	2	1	0	3	2	0	0		
Siskiyou	3	1	0	16	6	1	0		
Solano	454	45	16	975	45	5	1	0	
Sonoma	506	67	18	902	53	5	8	1	0
Stanislaus	629	98	56	994	114	21	1	0	
Sutter	131	5	1	153	9	1	0		
Tehama	64	18	9	129	22	3	3	0	
Trinity	6	1	1	22	5	0	0		
Tulare	218	34	9	585	92	5	0		
Tuolumne	15	3	0	115	25	1	2	2	0
Ventura	501	90	44	649	139	18	2	1	0
Yolo	862	115	40	797	120	14	1	0	
Yuba	56	2	1	128	4	0	0		
unknown	10	0		61	0		0		
Totals	**14,242**	**2,512**	**1,106**	**31,996**	**4,023**	**340**	**398**	**138**	**32**

[a] Tested by University of California at Davis Center for Vectorborne Diseases or local mosquito/vector control agency.

[b] Family Corvidae includes crows and ravens (*Corvus* spp.), magpies (*Pica* spp.), and jays (*Aphelocoma californica, Cyanocitta stelleri, Gymnorhinus cyanocephalus*).

[c] Includes fox (*Sciurus niger*), eastern gray (*S. carolinensis*), and western gray (*S. griseus*) squirrels

Source: California Department of Public Health

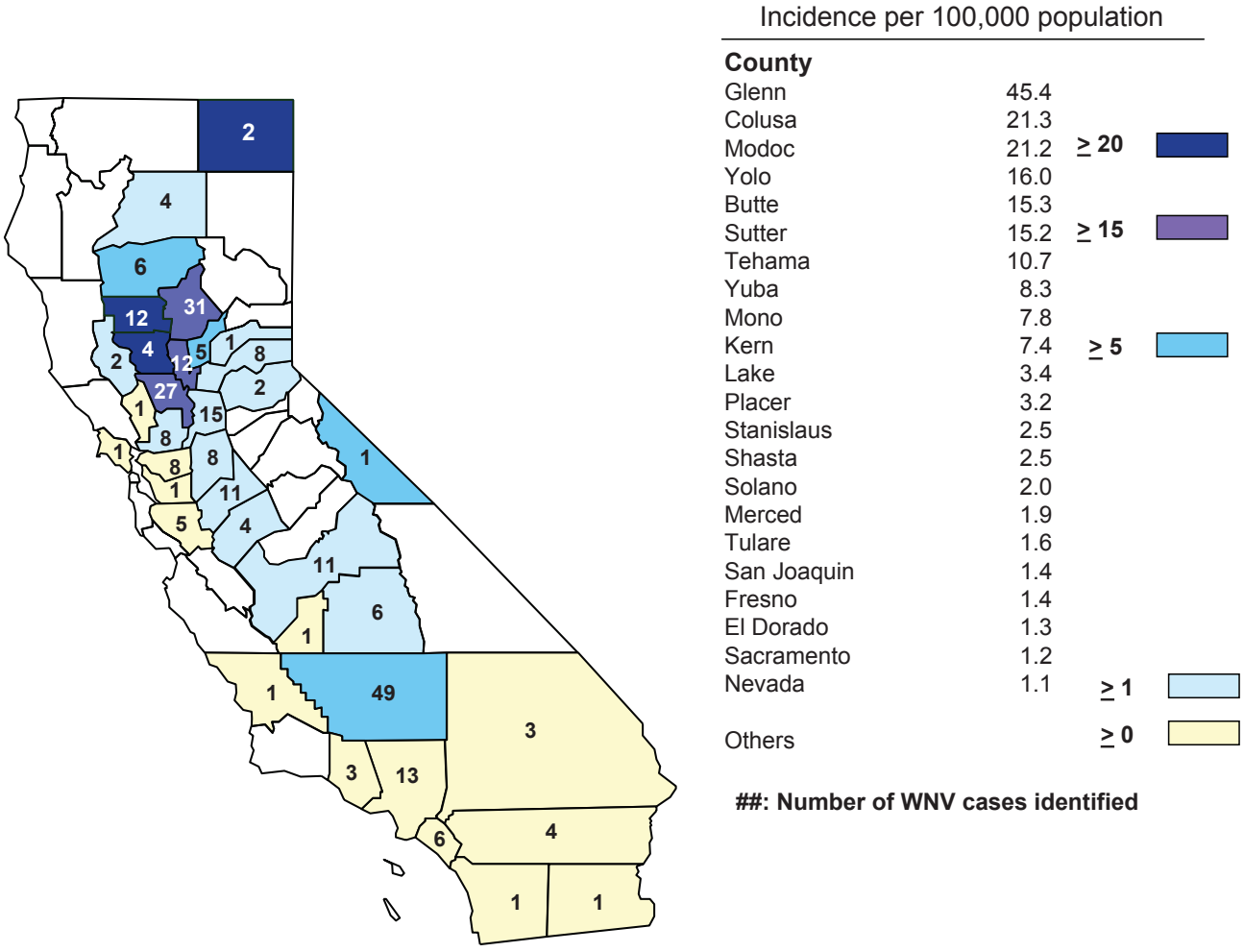


Figure 3. Human cases of West Nile virus (WNV) infection, California, 2006.

Source: California Department of Public Health

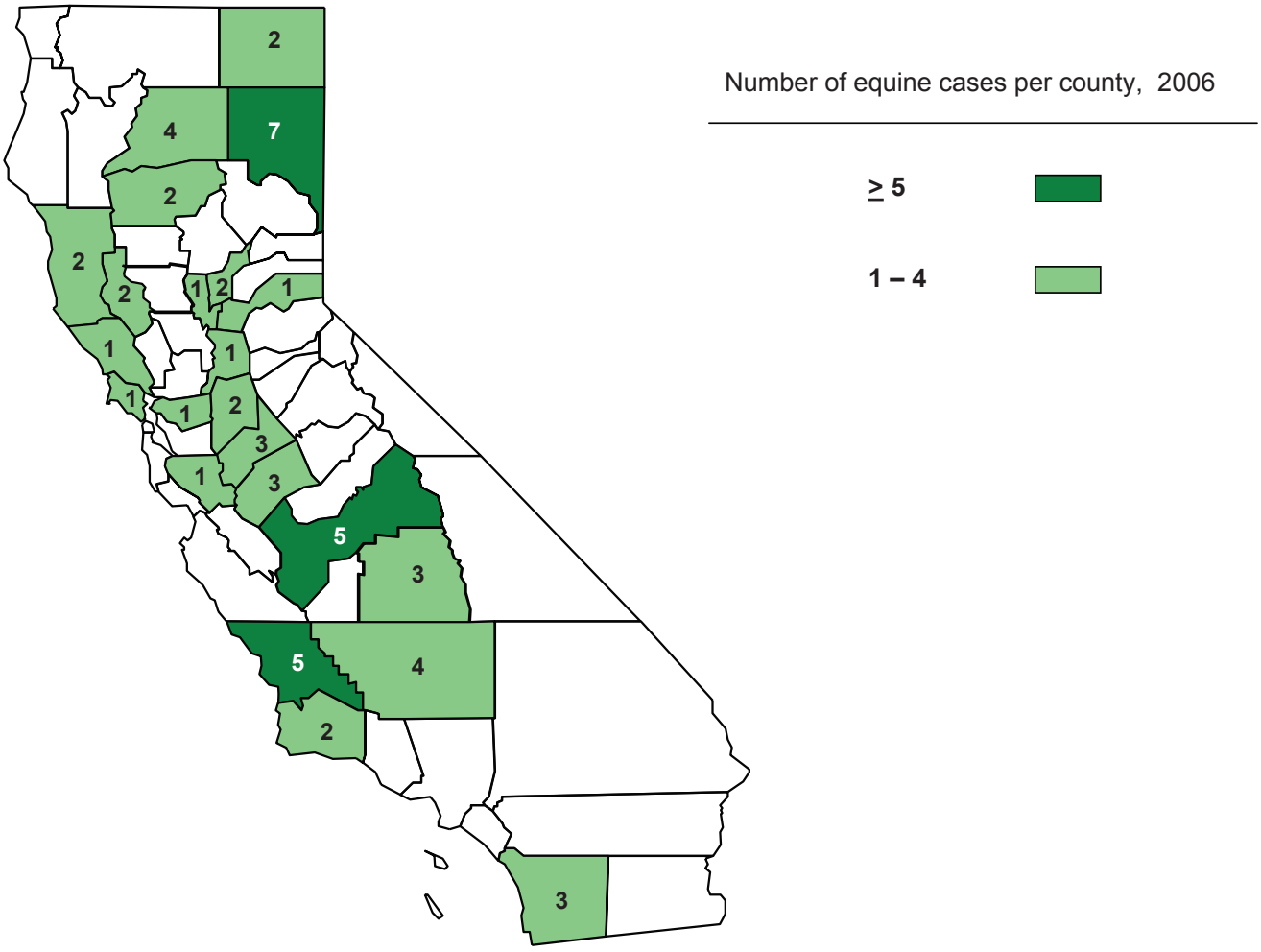


Figure 4. Equine cases of West Nile virus infection, California, 2006.

Source: California Department of Public Health

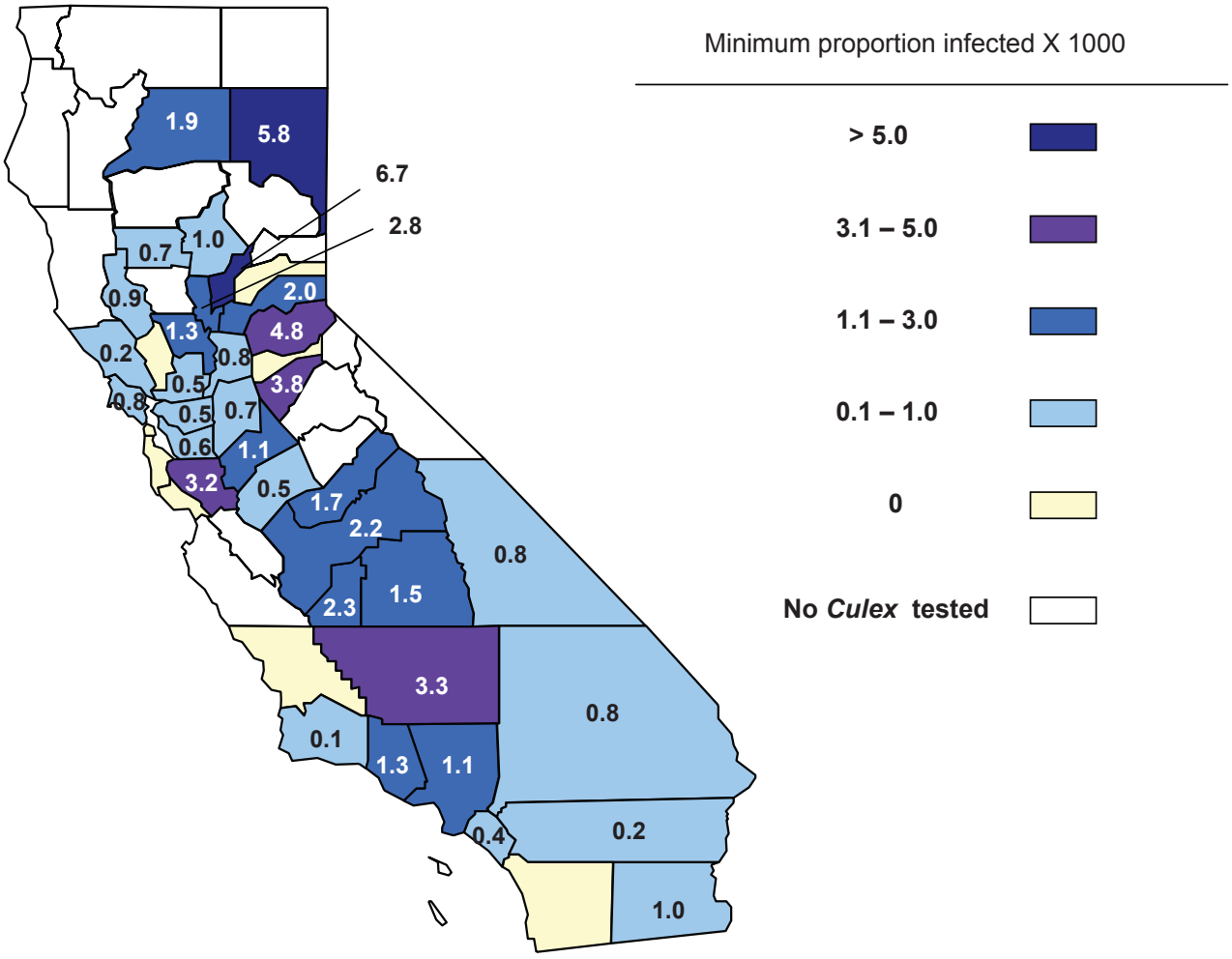


Figure 5. West Nile virus in *Culex* spp., California, 2006. Minimum proportion infected = Number of positive pools / Number of mosquitoes tested.

Source: California Department of Public Health

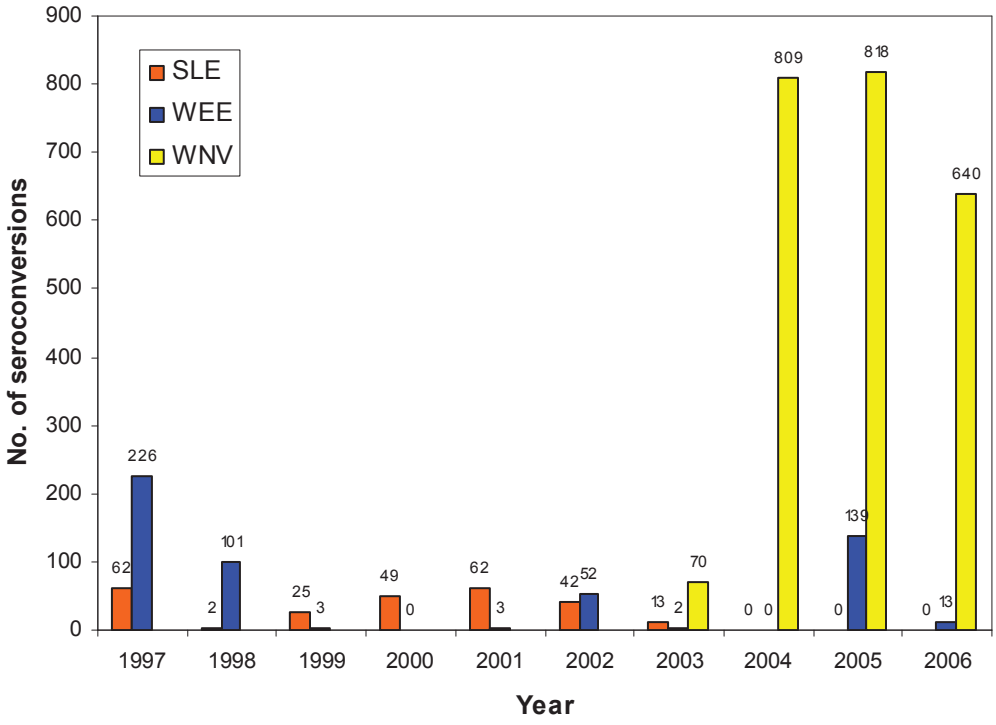


Figure 6. Sentinel chicken flock seroconversions to St. Louis encephalitis virus (SLE), western equine encephlomyelitis virus (WEE), and West Nile virus (WNV), California, 1997-2006.

Source: California Department of Public Health

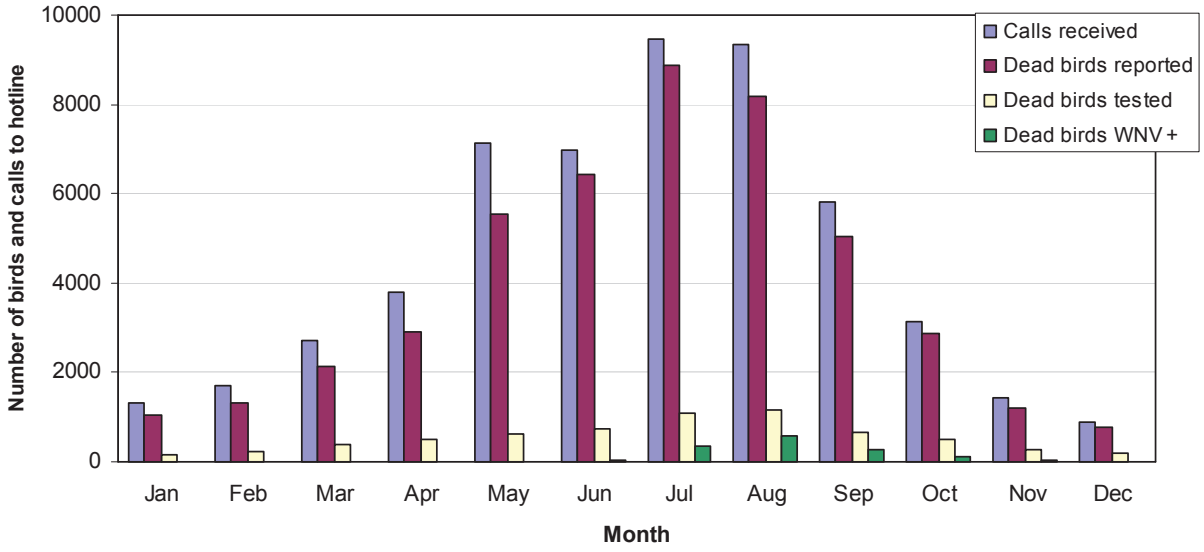


Figure 7. Calls and dead birds reported to the California Department of Public Health's West Nile virus (WNV) "Dead Bird Hotline," 2006.

Source: California Department of Public Health

Caltrans Stormwater Project Activities

Introduction and background

In 1997, the California Department of Transportation (Caltrans) initiated a Best Management Practice (BMP) Retrofit Pilot Program for treating stormwater runoff from selected facilities in Los Angeles and San Diego Counties. The objective of this program was to evaluate the installation and operation, as well as relative benefits and costs, of various structural "treatment" BMP devices for improving water quality. Caltrans retrofit 39 BMPs at 33 strategically selected project sites (e.g., freeway interchanges, park & rides, and maintenance stations) using eight different design types.

Concerned that treatment BMPs could potentially impact public health by increasing habitat available to aquatic stages of disease vectors, particularly mosquitoes, Caltrans and the California Department of Public Health, Vector-Borne Disease Section (VBDS) entered into a Memorandum of Understanding (MOU) in 1999. The primary objective of the MOU was for VBDS to provide technical expertise regarding vector production and the potential of vector-borne diseases within the Caltrans BMP Retrofit Pilot Program. It was the intent of this two-year agreement to document and, where possible, mitigate vector production and harborage at the BMP pilot project sites. Design and maintenance recommendations would be formulated to guide mitigation efforts.

1999-2001

In accordance with project goals, VBDS established a comprehensive vector surveillance and monitoring program and developed vector abatement protocols for the Caltrans BMP Retrofit Pilot Program. Data collected by VBDS and collaborating local vector control agencies between July 1999 and June 2001 revealed that a large percentage of BMP pilot designs, particularly those that held permanent standing water, supported production of mosquitoes. Concurrent with this investigation, VBDS surveyed over 150 agencies nationwide that had experience managing or monitoring similar stormwater devices. Survey results corroborated data collected from Caltrans BMPs (i.e., that these devices harbor and produce mosquitoes), providing additional evidence of the potential public health impact created by certain stormwater structures that lack specific provisions for vector management. VBDS offered Caltrans general and specific recommendations for mitigation of mosquito breeding in BMPs that included design changes, specific repairs, exclusion techniques, biological control, and maintenance intervals.

2001-2003

In June 2001, Caltrans and VBDS extended the MOU an additional two years to continue monitoring those BMPs built as part of the BMP Retrofit Pilot Program and to develop additional recommendations for mitigating vectors. Caltrans funding for local vector control agencies who previously worked with VBDS was also renewed to provide continued vector monitoring of selected BMPs, as well as several new BMP sites in San Diego, Orange, and Los Angeles Counties, and two BMP pilots in Siskiyou and Shasta Counties. VBDS periodically reviewed pre-construction plans for BMPs pilots, as requested by Caltrans.

2003-2005

In June 2003, Caltrans renewed the MOU for a third consecutive term through June 2007. Caltrans funding for local vector control agencies that collaborated with VBDS was also renewed. In accordance with this new agreement, VBDS expanded the size and scope of stormwater projects to include two new BMP studies in the Lake Tahoe region and one in Orange County. In addition, preliminary study trials were developed to determine the minimum developmental time of *Cx. tarsalis* in stormwater structures in and around South Lake Tahoe.

The South Lake Tahoe project was initiated in mid-2003 and data were collected from 32 study sites through October 2004. The objective of this study was to elucidate the role of urban BMPs to facilitate mosquito production in a developed alpine environment. Results provided evidence that some urban BMPs maintain breeding habitats for mosquitoes after naturally occurring breeding sites become dry. These urban habitats provided continued breeding opportunities for several opportunistic species, including *Culex tarsalis*, beyond their normal breeding season, where "normal" would represent a hypothetical condition without human encroachment. Project data was compiled, analyzed, and results published in 2005 in the Proceedings and Papers of the 73rd Annual Conference of the Mosquito and Vector Control Association of California (MVCAC). In June 2004, a companion study was initiated along the western and northern highways of Lake Tahoe (North Lake Tahoe project) to evaluate the mosquito production potential of specialized below-ground BMPs designed to capture traction sand (traction sand traps) from highways during snowmelt. Thirty traction sand traps, representing five designs, were selected along State Routes (SR) 28 and 89, and sampled for immature mosquitoes at five to nine day intervals, from July through October 2005. Standing water was observed frequently in many of the BMPs, although not all sites with water produced mosquitoes. *Culiseta incidens* was collected most frequently, whereas *Cx. tarsalis* and *Aedes* spp. were collected only once.

In 2004, VBDS began bimonthly monitoring of 24 retrofit BMP pilots installed along SR 73 in Orange County for evidence of vector production and/or conditions conducive to vector production. The scope and objectives of the Orange County project focused primarily on improving preventive design and maintenance practices. These retrofits represented a new generation of stormwater BMPs, many of which incorporated design features aimed at minimizing the potential for vector production while maintaining high standards for water quality improvement. Despite preventive measures considered in their design, many of these BMPs were observed to hold standing water and promote mosquito breeding during biweekly inspections in 2005. In most cases vector breeding was due to structural elements such as uneven earthen grades and insufficiently sloped (i.e., flat) concrete pads; however, construction flaws (e.g., uneven pipe grades), "experimental features" (i.e., skimmer devices), and periodic or perennial non-stormwater flows also contributed. VBDS provided Caltrans with detailed reports of biweekly site inspections and offered recommendations related to mosquito production as well as on-site safety. In turn, Caltrans took action to mitigate areas of concern as soon as practicable. VBDS worked cooperatively with Caltrans to implement incremental improvements to BMPs during 2005 that reduced habitat available for mosquitoes.

A preliminary study was designed and initiated in 2005 to estimate the minimum time required for *Cx. tarsalis* to develop from egg to pupa during the summer months in the Tahoe Basin. The sub-alpine ecology of the Tahoe Basin is unique in California, thus the developmental times of *Cx. tarsalis* may differ from published studies conducted in other areas or under different conditions. The trials served to refine field procedures to be implemented to a broader study scheduled for 2006.

Project Activities: 2006

Summary

- Continued biweekly inspections of traction sand trap BMPs installed along the western and northern highways of Lake Tahoe from late April to early May 2006.
- Completed analysis of the North Lake Tahoe project data and completed an interagency report for Caltrans.
- Continued biweekly inspections of BMP pilots installed along SR-73, Orange County.
- Prepared biweekly reports for Caltrans of observations and recommendations related to mosquito production at the Orange County BMP pilots.
- Prepared an interim project report for Caltrans summarizing findings of the Orange County project from 2004 and 2005.

- Initiated and completed a new study to measure the minimum developmental time of the immature stages of *Cx. tarsalis, Cx. pipiens,* and *Cx. quinquefasciatus* in stormwater management structures located in three ecologically distinct regions of California.
- Initiated and completed a study to determine if the physical structure and/or course of conveyance pipes leading to an enclosed breeding source could deter entry to female *Cx. quinquefasciatus*.
- Continued collaboration with local vector control agencies conducting vector surveillance at selected BMP sites.
- Maintained a Microsoft Access database of immature mosquito abundance in BMPs that were monitored by VBDS and collaborating vector control agencies.
- Presented seminars on issues pertaining to BMP devices and vector production at professional meetings, continuing education seminars, and informal meetings.
- Produced a one-hour "field-based" continuing education video for certified vector control technicians.
- Published a proceedings paper related to mosquito management in stormwater BMPs for the 4th International Engineering and Construction Conference
- Began preparing manuscripts summarizing projects completed to date for peer-reviewed publication.

Lake Tahoe Projects

The northern Lake Tahoe project, although initially intended to be a one-year study, was extended to include data collection during late April and early May 2006 in order to meet the study objectives. Project data were compiled, analyzed, and prepared as an interagency report for Caltrans. Results of the South Lake Tahoe and northern Lake Tahoe projects were combined and assembled into a manuscript for the *Journal of the American Mosquito Control Association.*

Orange County Project

In 2006, VBDS continued bimonthly monitoring of the 24 retrofit BMP pilots in Orange County for evidence of vector production and/or conditions conducive to vector production. Overall, structural mitigation efforts implemented by Caltrans in 2005 were successful during 2006. Available mosquito habitat was greatly reduced, except where persistent non-stormwater flows created situations difficult to control. VBDS continued to provide Caltrans with detailed reports of biweekly site inspections and offered recommendations as needed related to mosquito production and on-site safety. An interim project report was prepared for Caltrans highlighting observations made during 2004 and 2005 such as causes for standing water (Table 11).

Culex Development Project

A three-month summer study was designed, initiated, and completed in 2006 to estimate the minimum time required for *Cx. tarsalis, Cx. pipiens,* and *Cx. quinquefasciatus* to develop from egg to pupa in stormwater management structures located in three ecologically distinct regions of California: the Tahoe Basin, the Sacramento area, and the Los Angeles Basin. This project was designed to provide Caltrans with regional data on mosquito development that could be considered in design and maintenance decisions for new and existing stormwater treatment devices. Results of the study were compiled, analyzed, and prepared as an interagency report for Caltrans. Multiple linear regression analyses (Figure 8) and lower one-sided 95% tolerance limits suggested that under optimal conditions, a 96-hour water residence time in stormwater structures would not significantly elevate *Culex* production in California. These results provide BMP designers with an additional 24 hours of water detention flexibility compared to the previously recommended drain time of 72 hours.

Pipe Project

A three-month summer study was designed, initiated, and completed in 2006 to measure the distance that egg-laying female *Cx. quinquefasciatus* will fly through confined spaces, namely conveyance

oviposition within the confines of existing below-ground structures led to the development of an above-ground, modular system designed to simulate any number of below-ground water sources maintained in sumps, vaults, or basins. Results demonstrated the persistence of females to access sources of standing water for egg-laying through pipes of various lengths, diameters, and configurations. The number of egg rafts collected overnight in a single ovitrap during all trials (74 days) ranged from 0 to 126. Decreasing diameter and increasing pipe length were found to significantly reduce oviposition in the ovitraps, as did the addition of simple in-line elbows, suggesting that such configurations may hinder, but not eliminate, mosquito access to oviposition sites. However, it is unlikely that the pipe diameters (1.3, 5, and 10 cm) tested in this study have practical value for stormwater purposes. Results suggest that mosquito mitigation efforts in below-ground BMPs should focus on exclusion (i.e., mechanical barriers) or insecticides.

Education and outreach

In 2006, VBDS continued to prepare and present reports and provide recommendations on the potential public health impacts created by certain BMPs and the long-term implications associated with their construction. A special one-hour field-based continuing education video highlighting vector production in stormwater BMPs was prepared in collaboration with MVCAC for certified vector control technicians (See Publications and Presentations, page 58).

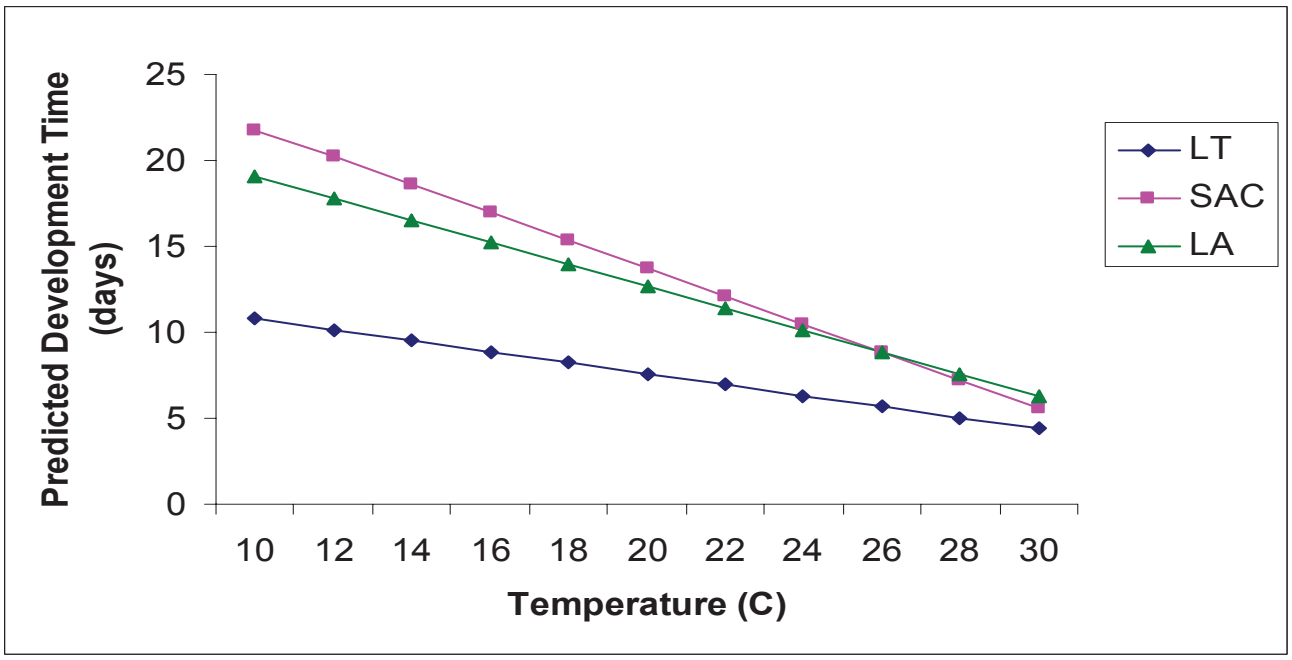


Figure 8. Average water temperature (°C) and predicted development times for *Culex tarsalis* larvae. Lines represent the slopes for average water temperature generated from separate multiple linear regression analyses of data from the Lake Tahoe Basin (LT, β_1= -0.32), the Sacramento Valley (SAC, β_1= -0.81), and the Los Angeles Basin (LA, β_1= -0.64) regions.

Source: California Department of Public Health

Table 11. Structural and non-structural causes of standing water in 24 Orange County Best Management Practice (BMP) pilots observed between June 2004 to December 2005 in descending order of frequency.

Structural Cause	***Number of Sites Affected***
Uneven basin grade	12
Uneven grade in conveyance pipe	5
Unsloped (i.e., flat) concrete pads	4
Malfunctioning outlet	3
Outlet clog	3[a]
Trash/Debris accumulation blockage	1
Loose rock riprap energy dissipater	1
Scour	1
Non-Structural Cause	***Number of Sites Affected***
Sediment accumulation at inlet	9
Non-stormwater flow	8

[a] Outlet clog due to water main failure not associated with BMP structure

Source: California Department of Public Health

United States Forest Service Activities

In 1992, the California Department of Public Health (CDPH) Vector-Borne Disease Section (VBDS) entered into a Challenge Cost-Share Agreement with the Pacific Southwest Region (Region 5 [R5]) of the United States Department of Agriculture Forest Service (USFS) to maintain cooperative surveillance and control of vector-borne diseases within the National Forests. The USFS and VBDS established this agreement to achieve mutually beneficial objectives in pest control and management, mandated by both federal and state law. VBDS and USFS R5 agreed to work cooperatively in planning and implementing vector-borne disease management programs.

In accordance with this agreement, VBDS staff conducted field activities in and/or provided educational and safety materials to the following R5 National Forests in 2006: Angeles, Cleveland, Eldorado, Inyo, Klamath, Lake Tahoe Basin Management Unit, Lassen, Los Padres, Mendocino, Modoc, Plumas, San Bernardino, Sequoia, Shasta-Trinity, Sierra, Six Rivers, Stanislaus, and Tahoe. In addition, a human fatality from hantavirus pulmonary syndrome was investigated on the Humboldt-Toiyabe National Forest (USFS Region 4). VBDS also provided consultation, certification, and oversight to autonomous agencies (environmental health departments and vector control agencies) concerning vector-borne diseases and pesticide applications for public health purposes on USFS land.

Activities conducted by VBDS staff in R5 National Forests included disease surveillance, risk assessment, risk reduction, and education of USFS personnel and concessionaires. Direct surveillance included the collection and testing of indicator species and vectors for plague, hantavirus, Lyme borrelioses, and tick-borne relapsing fever (Table 12); indirect surveillance included visual assessment of vector-borne disease risk factors (e.g., counting active rodents and evaluating rodent burrows for abandonment). Based on surveillance information, risk reduction recommendations for vector-borne diseases were made for recreational areas, fire stations, fire lookouts, employee residences, and work places. Recommendations included control of vectors, rodent management, habitat modification, and partial campground temporary closure. Educational activities involved providing information on specimen collection and identification, vector-borne disease epidemiology, and methods to reduce risk of infection. VBDS staff distributed posters, brochures, and wallet cards on plague, hantavirus, Lyme disease, tick-borne relapsing fever, tick identification, and West Nile virus to ranger district offices, USFS concessionaires, USFS fire stations, and individual campgrounds in regions endemic for these diseases. This report provides detailed information on VBDS activities in the R5 National Forests during 2006.

Table 12. Surveillance for selected vector-borne disease agents in U.S. National Forests, California, 2006.

National Forest	Hantavirus (deer mice)[a]		Plague (rodents)		Plague (carnivores)[b]		*Borrelia* spp. (*Ixodes* ticks)		*Borrelia hermsii* Surveillance[f,g]	
	Positive	Tested	Positive	Tested	Positive	Tested	Positive	Tested	Positive	Tested
Angeles			1	251[c]	0	3				
Cleveland	0	8	0	44	0	14	0	28		
Eldorado	4	54			0	2	2[d]	268		
Inyo	84	281	13	72					7	55
Lake Tahoe Basin	1	7	1	26	2	4			19	33
Lassen			0	1	1	7				
Los Padres			0	42	2	137				
Mendocino					0	10				
Modoc					9	20				
Plumas	17	118			13	27	0	29		
San Bernardino	1	45	0	122			0	4	7	62
Sequoia	0	16	0	10	0	2				
Shasta-Trinity										
Sierra	0	8	0	43	0	49	2[e]	68	8	49
Six Rivers							1[e]	113		
Stanislaus					0	5	0	92		
Tahoe	3	16	2	19	11	20	1	65	5	35
Humboldt-Toiyabe	19	41	0	25						
Total, All Forests	**129**	**594**	**17**	**655**	**38**	**300**	**6**	**667**	**46**	**234**

[a] Deer mice (*Peromyscus maniculatus*) only. Total rodents tested = 1184; total rodents seropositive = 165.

[b] Carnivore specimens taken directly from or immediately adjacent to USFS lands. Because of the broad home range of some carnivores, results obtained can be inferred to a large area, including both USFS and adjacent lands.

[c] Testing conducted by the Los Angeles County Department of Health Services.

[d] One of two positive pools tested positive for *Borrelia burgdorferi*, causative agent for Lyme disease.

[e] Tested positive for *Borrelia burgdorferi*, causative agent for Lyme disease.

[f] Columns show rodents tested for serum antibodies to *Borrellia hermsii*, causative agent for tick-borne relapsing fever, at the National Intstitutes of Health, Rocky Mountain Laboratory.

[g] One pool of two *Ornithodoros hermsi* ticks collected from the Sierra National Forest tested positive for infection with *B. hermsii*

Source: California Department of Public Health

VBDS ACTIVITIES IN REGION 5 NATIONAL FORESTS

Angeles National Forest

- Conducted direct plague surveillance in collaboration with Los Angeles County Department of Public Health Vector Management Program (LACDPH/VMP) at campgrounds and day use areas. One of 251 ground squirrels tested positive for serum antibodies to *Yersinia pestis*, the bacterial agent of plague.
- Responded to a request to test a rodent carcass for plague by Mill Creek Summit Fire Station personnel. The submitted ground squirrel tested negative by polymerase chain reaction (PCR) for *Y. pestis*.
- The Los Angeles County Agriculture Commissioner's office, in collaboration with LACDPH/VMP, applied approximately 742 pounds of Deltamethrin (0.05%) to ground squirrel burrows at 72 campgrounds and picnic sites covering 2,388 acres to control fleas and reduce the risk of plague transmission.
- Mailed a letter of introduction to the Forest Supervisor's office, five ranger stations, and all visitor information centers. Each letter also contained vector-borne disease educational pamphlets.
- Consulted with Forest Safety Officer and discussed VBDS services and opportunities for safety training.

Cleveland National Forest

- Conducted tick surveillance with a USFS volunteer team along the Upper San Juan Loop. No ticks were found.
- Conducted tick surveillance in collaboration with Riverside County Department of Environmental Health Vector Control Program (RDEH/VCP). Twenty-eight adult *Ixodes pacificus* collected from the Santa Rosa Plateau area were negative for *Borrelia* sp. by PCR testing.
- Conducted hantavirus surveillance at Pleasants Peak communication site. None of the four rodents collected had detectable serum antibody to Sin Nombre Virus (SNV).
- Conducted hantavirus surveillance in collaboration with San Diego County Department of Environmental Health/Vector Surveillance and Control Program (SDDEH/VSCP) at the following locations: near Boulder Oaks campground, San Luis Rey day use area, along Viejas Grade Road, Pine Valley Creek trailhead, Love Valley Meadow, and Lake Henshaw rest area. None of the 19 rodents collected had detectable serum antibody to Sin Nombre virus (SNV).
- Conducted direct plague surveillance at Oak Grove campground and fire station. Serum antibodies to *Y. pestis* were detected in none of the 10 ground squirrels tested.
- Conducted direct plague surveillance in collaboration and cooperation with SDDEH/VSCP at the following sites: Observatory, Cibbets Flat, Wooded Hills, Burnt Rancheria, and El Prado campgrounds. Serum antibodies to *Y. pestis* were detected in none of the 34 ground squirrels tested. Posted plague caution signs at Burnt Rancheria and El Prado campgrounds.
- Conducted indirect plague surveillance at Fry campground, Observatory Picnic Area, Upper San Juan, Blue Jay, Indian Flats, El Cariso, and Falcon Group campgrounds. Risk was estimated to be low at all sites.

- Met with the Volunteer Services Coordinator for the Cleveland National Forest, Trabuco District, and delivered public education materials for the more than 150 volunteers who work with the forest.
- Presented "Vector Borne Disease on Cleveland National Forest" talk to the Forest Supervisor's Office, and three District Rangers' offices reaching more than 150 USFS employees.
- Developed a squirrel control plan with USFS staff for Burnt Rancheria and Laguna/El Prado campgrounds where ground squirrels populations are excessive.
- Mailed a letter of introduction containing vector-borne disease educational pamphlets to the Forest Supervisor's office, District Ranger Stations, and the Emergency Dispatch Center.
- Responded to a USFS staff member request to detail rabies cases in San Diego, Orange, and Riverside Counties for the last ten years. Provided a packet of information on rabies prevention and incidence in California that will be distributed to USFS employees who enter abandoned mines.
- Drafted a letter for Lands and Special Uses Administration staff explaining prevention and control of hantavirus inside structures to distribute to contractors who service communication tower sites.
- Gave hantavirus education brochures to Orange County Metropolitan Water District employees cleaning rodent droppings at Pleasants Peak communications site.

Eldorado National Forest

- Conducted tick surveillance in January as part of the Occupational Exposure to Ticks Among USFS Employees project at three locations in the Georgetown Ranger District. Adult *Ixodes pacificus* ticks were collected by flagging (two hours per site) at the Georgetown Ranger Station (44 ticks), near the Pony Express trailhead on Road 11N65 (78 ticks), and Dru Barner Park campground (17 ticks).
- Conducted tick surveillance as part of the Occupational Exposure to Ticks Among USFS Employees project at three sites in May. Two person-hours of surveillance from each site yielded 14 *I. pacificus* adults and four *I. pacificus* nymphs from Georgetown Ranger Station, nine *I. pacificus* adults from Dru Barner Park, and 99 *I. pacificus* and one *Dermacentor occidentalis* from a trail and roadside located on Road 11N65. *I. pacificus* from the site along 11N65 tested positive for *Borrelia burgdorferi*, causative agent for Lyme disease, as well as another unspecified *Borrelia* sp.
- Conducted hantavirus surveillance at Lumberyard Fire Station in May and at Lumberyard and Leeks Springs lookout in June with 16 and 20 total deermice captured, respectively. Detectable serum antibodies to SNV were found in two mice (12.5% seroprevalence) captured in May from Lumberyard and one mouse each from Lumberyard and Leek Springs lookout in June (10% seroprevalence).
- Presented "Vector-Borne Disease Prevention" at the Sierra Nevada Research Center All Staff Meeting in Placerville.
- Distributed educational brochures on plague, hantavirus, Lyme disease, and West Nile virus to the Pioneer and Pacific Ranger Districts.

Inyo National Forest

- Conducted tick-borne relapsing fever (TBRF) surveillance at Crestview Fire Station. Six of 17 (35%) rodent samples were positive for antibodies to *Borrelia hermsii*, causative agent for TBRF.
- Conducted TBRF surveillance at Lee Vining Ranger Station. Seven of 55 (13%) rodent sera were positive for antibodies to *B. hermsii*.
- Initiated a hantavirus surveillance project at Lee Vining Ranger Station as part of a long-term, mark-recapture Hantavirus Risk Assessment project. Surveillance events were conducted in June, August, and October. Six trapping events totaling 600 trap-nights yielded sera from 281 *Peromyscus maniculatus*; 84 (30%) samples had detectable serum antibodies to SNV.
- Conducted direct plague surveillance at Sherwin Creek Campground in May. Thirteen rodents were trapped with one least chipmunk positive for serum antibodies to *Y. pestis* with a titer of 1:2,048. Selected, temporary campsite closures were initiated in the vicinity of the animal's capture. Closed campsites were reopened after concessionaire education, individual camper notification, and close evaluation of the campground were completed. Plague warning signs were posted throughout the campground and all campers were given the CDPH plague educational brochure.
- Conducted direct plague surveillance in May at New Shady Rest and Pine Glen campgrounds. Serum antibodies to *Y. pestis* were not detected in two ground squirrels tested.
- Conducted direct plague surveillance at Aspen campground in June. Serum antibodies to *Y. pestis* were detected in none of the five rodents tested.
- Conducted direct plague surveillance at Four Jeffrey campground in July. Serum antibodies to *Y. pestis* were detected in none of the 20 rodents tested.
- Conducted direct plague surveillance at Crestview Fire Station, and Deadman and Glass Creek campgrounds in July. Serum antibodies to *Y. pestis* were detected in none of the 28 rodents tested.
- Conducted direct plague surveillance at Saddlebag, Junction and Ellery Lake campgrounds. Sciurid rodents were observed at all locations; sera were not collected from the two chipmunks trapped.
- Conducted indirect plague surveillance at Twin Lakes and Lake Mary campgrounds in May. Campgrounds were closed but chipmunks and ground squirrels were very active. Numbers appeared to be moderate to high.
- Conducted indirect plague surveillance at Grandview campground and Schulman Visitor Center. Moderate to high numbers of golden-mantled ground squirrels and chipmunks were observed. No historical plague information exists concerning these areas.
- Conducted indirect plague surveillance at the following campgrounds in July: Onion Valley, Big Pine Creek, Upper Sage Flat, Sage Flat, Sabrina, North Lake, and Intake 2. None of the campground hosts reported unusual rodent behavior, or sick or dead rodents. Moderate to high numbers of sciurid rodents were noted at all campgrounds.
- Conducted indirect plague surveillance at Pumice Flat campground in August.
- Presented vector-borne disease awareness training to approximately 400 USFS employees at the annual All Employee Meeting in Mammoth Lakes. Provided brochures on plague, hantavirus, and West Nile virus and wallet size tick identification cards to attendees.

- Met with Forest Safety Officer to discuss vector-borne disease issues.

Klamath National Forest

- Conducted a hantavirus visual inspection at the Grass Lake Fire station. Discussed the problems associated with the contracted pest control service's continued use of glue boards for mice removal.
- Conducted indirect plague surveillance at Juanita Lake and Martins Dairy campgrounds. Both campgrounds are posted with plague caution signs. Juanita Lake golden-mantled ground squirrels and chipmunks were active. Martins Dairy had low rodent activity. Yellowjackets (*Vespula pensylvanica*) did not appear to be a problem at either location.
- Visited the Goosenest Ranger Station and Grass Lake Fire Station. Provided vector-borne disease brochures and plague caution posters to the Resource Officer and discussed statewide plague and hantavirus activity.

Lake Tahoe Basin Management Unit

- Conducted TBRF surveillance at the Tallac visitor center in South Lake Tahoe, and at the nearby USFS workstation. Nineteen of 33 (58%) rodent sera had detectable antibodies to *B. hermsii*.
- Conducted hantavirus surveillance at the Tallac visitor center and the nearby USFS workstation. One of seven *P. maniculatus* collected had detectable serum antibody to SNV.
- Conducted direct plague surveillance at the Tallac visitor center and the nearby USFS workstation. Eighteen yellow pine chipmunks, one shadow chipmunk, two golden-mantled ground squirrels, and five California ground squirrels were submitted for testing. One California ground squirrel was positive for serum antibodies to *Y. pestis* at a titer of 1:128.

Lassen National Forest

- Tested a golden-mantled ground squirrel carcass submitted from Hat Creek campground for evidence of plague. Results were negative by PCR.
- Conducted indirect plague surveillance in June at Gurnsey Creek and Battle Creek campgrounds. Both sites had plague signs posted and few rodents were noted. At Battle Creek, six golden-mantled ground squirrels were seen in 20 camp sites surveyed in the lower loop. At Gurnsey Creek, an average of less than one rodent per five sites was noted in one of twp loops that were open at the time.
- Visited the Recreation division at Eagle Lake Ranger District in April. Discussed with the district's new Recreation Officer plague history at District recreation sites and protocol to submit rodents for testing. Educational brochures for vector-borne diseases and plague caution posters were provided for use at recreation sites in the District.
- Visited the Almanor Ranger District office in May and discussed vector-borne disease issues. Plague caution posters and vector-borne disease educational brochures were provided for staff and visitor use. VBDS staff requested that the new plague posters replace older versions posted at recreation sites throughout the District.

Los Padres National Forest

- Conducted tick surveillance in June as part of the Occupational Exposure to Ticks Among USFS Employees project at the Los Prietos Ranger Station and Figueroa Work Station. Forty-nine *Dermacentor* ticks were collected.
- Conducted direct plague surveillance at Chuchupate Ranger Station. Serum antibodies to *Y. pestis* were detected in none of 22 rodents tested and the flea index remained low.
- Conducted direct plague surveillance at Upper Oso campground. Serum antibodies to *Y. pestis* were detected in none of 10 ground squirrels tested and the flea index remained low despite high squirrel abundance.
- Conducted direct plague surveillance at Mt. Pinos campground. Serum antibodies to *Y. pestis* were detected in none of the 10 rodents tested.
- Conducted indirect plague surveillance at Paradise and Sage Hill Group campgrounds, where ground squirrels were numerous, and at First Crossing Day Use Area where squirrels were not abundant.
- Conducted indirect plague surveillance at McGill campground. Plague risk was estimated to be low due to the relatively low density of sciurid rodents.
- Attended a pre-cleaning safety meeting at Los Prietos Ranger Station. Personnel were advised of hantavirus risks and the site slated for cleaning was inspected.
- Informed Monterey Ranger District and campground concessionaire of a positive *B. burgdorferi* collected at Arroyo Seco campground in 2005. Supplied USFS personnel and concessionaires with posters, brochures, and tick warning signs.
- Educated new campground hosts about vector-borne diseases.
- Advised USFS biologists regarding reported ground squirrel poisoning and concerns for California condors.

Mendocino National Forest

- Met with the Safety Officer to discuss hantavirus safety protocols and concerns about facilities and personnel.
- Distributed vector-borne disease brochures to the Supervisor's headquarters in Willows in May. Provided additional brochures for distribution to the Grindstone Ranger District for use by employees at district fire stations and lookouts.

Modoc National Forest

- Conducted indirect plague surveillance at Stough Reservoir campground in June. No ground squirrels were observed but yellow-pine chipmunks were active at the site. Plague caution signs were confirmed to be posted.
- Visited the Forest Supervisor's office in Alturas. Vector-borne disease issues were discussed with the Forest Public Services Officer and the Recreation Officer for the Warner Mountain Ranger District. Plague caution signs and educational brochures on other vector-borne diseases were provided for further distribution to the Big Valley, Devils Garden, and Doublehead Ranger Districts.

Plumas National Forest

- Continued a multi-year hantavirus risk study at Laufman Fire Station, Beckwourth Ranger District. Using mark-recapture methods, 605 rodents were trapped at the site during 12 trap-night periods (two trap-nights per visit) from April to October. An additional nine rodents were collected in April from a site approximately one mile north of the fire station. Antibodies to SNV were detected in 48 of 613 sera, including 17 of 121 *P. maniculatus*, tested at the CDPH Viral & Rickettsial Disease Laboratory. The percent of *P. maniculatus* with serum antibodies to SNV ranged from six percent in August to 29 percent in May. Five of 17 seropositive *P. maniculatus* were captured in or around structures. The total number of rodents sampled in 2006 (trap success = 28.8%) was appreciably more than 2005 (trap success = 5.9%), suggesting a significant increase in population size. Staff were advised to continue rodent exclusion efforts, maintain clean barracks, and to keep a clean perimeter around all structures to minimize potential rodent habitat.
- Conducted indirect plague surveillance at Antelope Lake, Mt. Hough Ranger District, during May. Campgrounds were checked for rodent activity and plague caution signs. Contacts were made with the managing concessionaire for the three campgrounds operating at the lake. Rodent-borne disease issues and the need to report suspicious rodent disappearance or die-offs to USFS recreation personnel were discussed. Educational brochures and plague caution signs were provided. Few golden-mantled ground squirrels were noted at Boulder Creek and Lone Rock campgrounds (<1 per five campsites) during this early season visit.
- Discussed rodent-borne disease issues with the Beckwourth Ranger District Recreation Officer. Rodent submission protocol for plague testing was discussed. Provided plague caution signs and vector-borne disease educational brochures. VBDS requested that the new plague signs replace any currently displayed at district campgrounds.

San Bernardino National Forest

- Conducted TBRF surveillance in November and December at Big Pine Flat Fire Station, Big Bear Ranger Station, Deer Lick Fire Station, and Sky Forest Ranger Station. Seven of the 62 (11%) rodents had serum antibodies to *B. hermsii*. One *O. hermsi* larva was collected from a rodent nest and was negative for *B. hermsii*. In December, serum antibodies were detected in none of 13 and 43 rodents tested for SNV and *Y. pestis*, respectively.
- Conducted tick surveillance in collaboration with RDEH/VCP. Four adult *I. pacificus* collected from the Santa Rosa Mountain area were negative for *Borrelia* sp. by PCR.
- Investigated a hantavirus pulmonary syndrome (HPS) case in cooperation with San Bernardino County Vector Control Program on USFS land leased to a private entity. One of the 37 rodents collected had detectable serum antibody to SNV.
- Conducted direct plague surveillance at Applewhite campground. Serum antibodies to *Y. pestis* were detected in none of the 12 ground squirrels tested.
- Conducted direct plague surveillance in collaboration with RDEH/VCP at Marion Mountain, Fern Basin, Dark Canyon, and Boulder Basin campgrounds. Serum antibodies to *Y. pestis* were detected in none of the 77 rodents tested.
- Conducted indirect plague surveillance at South Fork, San Gorgonio, and Barton Flats campgrounds. Risk was estimated to be low due to low rodent numbers, no evidence

of burrow abandonment, and no reports by campground hosts of dead or dying rodents. Plague caution signs were posted at all campgrounds.
- Distributed brochures on TBRF to USFS firefighters at Deer Lick Fire Station, Big Bear Ranger Station, and Sky Forest Ranger Station.
- Presented "Hantavirus in California" to the Desert Managers Group meeting at the Visitor's Center in Fawnskin.

Sequoia National Forest

- Conducted direct plague surveillance at Peppermint Work Center where evidence of a possible plague epizootic was noted. Serum antibodies to *Y. pestis* were detected in none of the 10 rodents tested.
- Conducted direct plague surveillance at Kennedy Meadows campground. Serum antibodies to *Y. pestis* were detected in none of the six ground squirrels tested.
- Conducted indirect plague surveillance at Fish Creek and Troy Meadow campgrounds. Risk was determined to be low at both campgrounds based on low visual rodent counts, no abandoned rodent burrows, and no previous plague history.
- Conducted indirect plague surveillance at the following campgrounds: French Gulch Group Camp, Pioneer Point, Hungry Gulch, Boulder Gulch, Tillie Creek, Live Oak, Headquarters, Hospital Flat, Camp 3, and Fairview. Risk was determined to be low-to-moderate at all campgrounds surveyed. Discussed plague precautions with USFS personnel at two ranger stations and concessionaires.
- Distributed plague and hantavirus brochures to USFS personnel at Black Rock Work Center.

Shasta-Trinity National Forest

- Conducted adult tick surveillance at three recreation sites in January. Ticks were collected from Hirz Bay campground (65 ticks), Dekkas Rock (25), and Nelson Point (30) recreation sites. Ticks were not retained for testing.
- Conducted adult *Ixodes* tick surveillance at four recreation sites on Lake Shasta in February. Adult ticks were collected from McCloud Bridge (37 ticks), Pine Point Campground (52), Nelson Point (30), and Hirz Bay Campground (82).
- Conducted adult tick surveillance at two recreation sites on Shasta Lake in early May. Eight *I. pacificus* and eight *D. occidentalis* ticks were collected from Hirz Bay campground and seven *I. pacificus* and 17 *D. occidentalis* were collected at Pine Point campground. *Ixodes* ticks were retained for seasonal distribution records.
- Participated in the 2006 Health and Safety Fair held at the Supervisors' Headquarters facility in Redding. Provided vector-borne disease educational brochures and fielded questions regarding vector issues from USFS staff.
- Contacted the Safety Officer regarding vector-borne disease issues and employee safety in the forests under his jurisdiction. Provided vector-borne disease educational brochures, posters, and tick wallet cards as well as updates on VBDS services related to hantavirus and tick-borne disease investigations that had been previously conducted.

Sierra National Forest

- Conducted tick surveillance at three USFS worksites as part of the Occupational Exposure to Ticks Among USFS Employees project. Sixty-two adult *I. pacificus* and four adult *D. occidentalis* were collected at Road 6513H near Chepo Saddle. Five adult *I. pacificus*, one nymphal *I. pacificus*, and four adult *D. occidentalis* were collected at Road 6510 near Batterson Station. No ticks were collected at Mt. Rest Station. Two pools of *I. pacificus* collected at Chepo Saddle tested positive by PCR for *B. burgdorferi*.
- Conducted a TBRF case investigation at a private residence on USFS land located at Huntington Lake. Two engorged female adult *O. hermsi* ticks tested positive for *B. hermsii*. Additionally, one *O. hermsi* nymph was collected from a rodent nest located and removed from a fireplace in the bedroom. Provided safety and prevention recommendations to TBRF case-patient and other residents in the neighborhood on reducing risk ofTBRF and other rodent-borne diseases.
- Conducted surveillance for TBRF, hantavirus, and plague at Upper and Lower Billy Creek campgrounds, and at the West Dowville Tract located in Huntington Lake. Eight of 41 (20%) rodents tested positive for antibodies to *B. hermsii*. Serum antibodies to *Y. pestis* were detected in none of 39 rodents tested. None of the 18 *P. maniculatus* collected had serum antibodies to SNV.
- Conducted direct plague surveillance at the Rancheria campground located in Huntington Lake. Very little rodent activity was observed. Serum antibodies to *Y. pestis* were detected in none of the four chipmunks tested.
- Presented “Tick-borne Diseases of California” at the Sierra National Forest Safety Meeting.
- Presented vector-borne disease awareness training to USFS employees at the High Sierra Ranger District safety meeting.
- Distributed brochures on Lyme disease, plague, hantavirus, and West Nile virus to the North Fork Ranger District. Brochures and plague caution signs were distributed to the district Safety Officer.

Six Rivers National Forest

- Conducted tick surveillance as part of the Occupational Exposure to Ticks Among USFS Employees project at two sites in the Lower Trinity Ranger District. Sixteen *I. pacificus* adults, three *I. pacificus* nymphs, and 19 *D. occidentalis* were collected at Salyer during one person-hour of flagging. One *I. pacificus* pool from this location was positive by PCR for *B. burgdorferi*. One *I. pacificus* and one *D. occidentalis* were collected in 10 minutes of flagging near Sandy Bar.
- Conducted tick surveillance as part of the Occupational Exposure to Ticks Among USFS Employees project at three sites in the Smith River Ranger District. Thirty-one *I. pacificus* and seven *D. occidentalis* ticks were collected during one person-hour of flagging along Middle Gasquet Road, near Elk Creek Camp. Five *I. pacificus* and one *D. occidentalis* were collected in one person-hour of flagging near the waste station on Middle Gasquet Road. One *I. pacificus* tick was collected in one person-hour of flagging at Gasquet Mountain on Road 17N49.
- Conducted tick surveillance as part of the Occupational Exposure to Ticks Among USFS Employees project at two sites in the Orleans Ranger District. Thirty-eight *I. pacificus*

adults and three *D. occidentalis* were collected from Road 11N48 off of Eyesee Road during 1.5 person-hours of flagging. Sixteen *I. pacificus* and 10 *D. occidentalis* were collected in two person-hours of flagging at Perch Creek campground.
- Discussed vector-borne disease issues and the development of a response plan for avian influenza in R5 with the Safety Officer.
- Delivered educational materials including tick cards, tick work-place posters, West Nile virus, Lyme disease, and plague brochures to the Gasquet, Orleans, and Lower Trinity Ranger Stations.

Stanislaus National Forest

- Conducted tick surveillance as part of the Occupational Exposure to Ticks Among USFS Employees project at three sites. Ten adult and two nymphal *I. pacificus* were collected in two person-hours of flagging at Keltz Mine, Road 3N92. Thirteen *I. pacificus* adults and five *I. pacificus* nymphs were collected in 1.5 person-hours of flagging at South Fork Road. Three *I. pacificus* adults and one *I. pacificus* nymph were collected during 1.7 person-hours of flagging at Mt. Provo Road.
- Visited the following campgrounds in June: Baker, Boulder Flat, Brightman, Cascade Creek, Clark Fork (loops A and B and Horse Camp), Dardanelle, Deadman, Eureka Valley, Fence Creek, Fraser Flat, Hull Creek, Meadowview, Niagara, Niagara OHV, Pigeon Flat, Pinecrest, Pioneer Group, and Sand Flat. New plague caution signs were posted as needed. Campground hosts were provided vector-borne disease brochures and educated about the recent increase in plague activity in the state.
- Discussed vector-borne disease issues with the Forest Safety Officer and Recreational Safety Officer.
- Presented a talk entitled “Risk Assessment and Prevention of Vector-Borne Diseases in Stanislaus National Forest” at the Safety Officer’s meeting in November.
- Provided Summit Ranger Station and Brightman forest office with vector-borne disease brochures and tick cards. Educational materials including tick cards, tick work-place posters, West Nile virus, Lyme disease, hantavirus, and plague brochures were delivered to the Mi-Wok Ranger Station.
- Checked Highland Lakes, Pacific Valley, Hermit Valley, Mosquito Lake, and Lake Alpine campgrounds in mid-May for rodent and mosquito activity. All campgrounds were still closed. West Nile virus, plague, and hantavirus brochures and plague caution signs were left with campground hosts.

Tahoe National Forest

- Conducted tick surveillance as part of the Occupational Exposure to Ticks Among USFS Employees project at the Ranger Station in Nevada City in January. Fifty *I. pacificus* adult ticks were collected in 0.5 person-hours of flagging along the edge of the facility’s north parking lot.
- Conducted tick surveillance as part of the Occupational Exposure to Ticks Among USFS Employees project at the Supervisor’s office in Nevada City in May. Two adult, 13 nymphal, and three larval *I. pacificus* ticks were collected from the edges of the upper parking lot in one person-hour of flagging.

- Conducted direct plague surveillance at San Francisco State College Field Station. Two of 19 rodents tested positive for serum antibodies to *Y. pestis* with titers of 1:64.
- Conducted indirect plague surveillance at the following campgrounds and work areas: Prosser, Lakeside, Boca Springs, Boca Rest, Boca, Logger, and Sagehen Creek. No physical evidence of plague epizootic activity was observed at any of these sites. Sagehen Creek, Boca, Prosser, and Logger had significant numbers of sciurid rodents. All campgrounds were posted with plague caution signs and, when possible, campground hosts and personnel were given plague and hantavirus information.
- Gave presentations on tick-borne disease prevention to North Yuba, Foresthill, and the Nevada City Ranger Districts at their office safety training seminars. Brochures and educational materials on Lyme disease and other tick-borne diseases were distributed during these seminars.
- Provided the Truckee Ranger Station with plague caution signs for posting in campgrounds and plague and hantavirus brochures for dissemination to the public.

Humboldt-Toiyabe National Forest

- Conducted a field investigation of a fatal HPS case at Robinson Creek campground. Ninety Sherman live traps were set for overnight trapping and yielded 81 rodents. Nineteen of 41 (46%) deer mice tested positive for serum antibody to SNV, including four of seven mice from the two campsites the decedent had occupied. Serum antibodies to *Y. pestis* were detected in none of the 25 rodents tested.
- Checked Crystal Springs, Hope Valley, Kit Carson, Snowshoe, Silver Creek, Markleeville, Mount Rose, Wolf Creek, and Highland Trail campgrounds in mid-May for rodent and mosquito activity.

SPECIAL PROJECT: Occupational Exposure to Ticks among USFS Employees

In July 2005, staff of VBDS and the CDPH California Epidemiologic Investigation Service (Cal-EIS) program initiated a year-long project to assess tick bite prevention practices of USFS R5 personnel and the potential for staff to acquire tick bites on USFS lands. The study attempted to identify risk factors for exposure to tick bites among USFS employees and measures that might be easily adopted to reduce such exposure. Eight hundred fourteen R5 personnel completed a survey of knowledge, attitude, and practices relative to ticks and tick-borne diseases. Additionally, tick surveillance was conducted at 32 sites in eight National Forests. Nearly 700 of the *Ixodes* ticks collected from these sites were tested for *Borrelia* spp. through a cooperative agreement with the U.S. Army Center for Health Promotion and Preventive Medicine. A comprehensive project report was delivered to the R5 Safety Officer in October 2006 for distribution throughout the region and may serve as a basis from which safety and education protocols can be appropriately developed.

SPECIAL PROJECT: Risk Factors for Contracting Tick-borne Relapsing Fever at USFS Facilities

In July 2006, staff of VBDS and the CDPH Cal-EIS initiated a year-long project to evaluate the prevalence of risk factors for contracting TBRF at R5 USFS facilities used for overnight stays.

Project goals include documenting the presence of factors contributing to the risk of contracting TBRF while residing at a USFS facility, documenting species of rodents infected with *B. hermsii* in R5 National Forests, and providing education and recommendations for reducing the risk of contracting TBRF. Surveillance sites were selected based on exposure information from known cases and information gathered from R5 USFS personnel about facilities that may pose a risk of TBRF. Surveillance sites for this project are located in the following National Forests:

- Tahoe National Forest
- Lake Tahoe Basin Management Unit
- Inyo National Forest
- Eldorado National Forest
- San Bernardino National Forest
- Sierra National Forest
- Lassen National Forest
- Plumas National Forest

It is anticipated that the results of this project will serve as the basis from which safety protocols may be developed as well as provide information regarding the distribution of *B. hermsii* among the rodent populations of R5 National Forests.

OTHER SERVICES PROVIDED:

- Sent out a pre-season letter to all USFS R5 Supervisors, District Offices, and campground concessionaires via an electronic mail distribution list. This letter described the services the VBDS staff can provide to the USFS and included contact information for VBDS biologists.
- Sent a special alert to all R5 Forests via Safety Officers concerning the increased risk of plague on and around USFS lands in California.
- Provided training in vector-borne disease epidemiology and vector control to USFS personnel, as well as to county environmental health departments and vector control districts that work on USFS lands. Training is provided through annual workshops, special seminars and presentations, and hands-on field training.
- Updated a contact list of USFS biologists, district rangers, fire management officers, recreation officers and safety officers for each R5 Forest. This contact list enables VBDS biologists to communicate investigation and surveillance findings to appropriate USFS personnel and helps to ensure that all areas within R5 receive service by VBDS.
- Provided the USFS section of the 2005 VBDS Annual Report to the CDPH Vector Control Advisory Committee during its annual Sacramento meeting.
- Continued the multi-agency tick surveillance study to better understand the ecology of *I. pacificus* ticks and tick-borne disease transmission risk in Southern California, certain study sites of which are within San Bernardino National Forest. This surveillance project is being conducted in collaboration with RDEH/VCP.
- Distributed tick identification cards to R5 Headquarters and numerous Ranger Districts throughout R5.
- Developed and distributed a new brochure addressing TBRF.

- Presented “Vector-Borne Diseases in Region 5: Challenges for Safety Officers and Occupational Exposure to Ticks among USFS Employees” at the annual Safety Officer meeting in Pacific Grove.
- Presented “The Challenge Cost-Share Agreement: Healthy Forests with Healthy People” to USFS R5 Supervisors at their USFS R5 Partnership meeting in Sacramento.
- Sent a report to the R5 Safety Office regarding the test results and findings concerning the fatal HPS case who was likely exposed at Robinson Creek campground on the Humboldt-Toiyabe NF (Region 4).

Other Vectors and Public Health Pests

Head lice (*Pediculus humanus capitis*)
The California Department of Public Health (CDPH) altered its recommendation on control of head lice in schools to no longer advocate removal and exclusion of students with “nits” (lice ova). The new recommendations, published in January in the revised “Guidelines on Head Lice Prevention and Control for School Districts and Child Care Facilities, 2006,” include routine screenings of school-age children, treatment of children with live lice, and education on head lice for parents, teachers, and other caregivers.

Bed bugs (*Cimex lectularis*)
CDPH Vector Borne Disease Section (VBDS) provided numerous consultations to local health departments regarding an apparent resurgence of bed bug infestations in hotels, nursing homes, public housing, apartment complexes, and other multi-unit dwellings throughout California. VBDS developed guidelines for bed bug prevention and control in California; established weblinks to disseminate accurate information on bed bug biology, inspection, treatment and control; created public outreach materials; and established collaborations with academic researchers conducting bed bug research.

Africanized Honey Bees (*Apis mellifera scutellata*)
In 1994, Africanized Honey Bees (AHB) entered California near Blythe. Through 2006, the California Department of Food and Agriculture (CDFA) reported that AHB have spread throughout southern California south of the Tehachapi Mountains, in particular the desert regions of Imperial, Riverside, and San Bernardino Counties. North of the Tehachapis, AHB have been detected in Inyo, Kern, and Tulare Counties and as far north as Madera County. Along the southern California coast, isolated AHB detections have occurred as far north as San Luis Obispo County. Occasional human and domestic pet stinging incidents continue to be locally reported from the southern region of the state.

Red Imported Fire Ant (*Solenopsis invicta*)
VBDS continued in its role as liaison with CDFA and local agencies conducting Red Imported Fire Ant (RIFA) eradication programs in 2006. CDFA reported that it treated over 16,000 primarily agricultural acres in Fresno, Madera, Merced, and Stanislaus Counties for RIFA infestations. A RIFA infestation at Cal-Expo in Sacramento County was declared eradicated in 2006.

The Coachella Valley Mosquito and Vector Control District performed over 3,300 treatments at 4,308 RIFA sites covering over 34,000 acres in Riverside County. Sixty-seven square miles of Riverside County remain under RIFA quarantine. The Orange County Vector Control District Fire Ant Program conducted or contracted over 4,000 treatments on infested properties in Orange County. All of Orange County (790 square miles) remains under RIFA quarantine. The Los Angeles County Agricultural Commissioner/Weights & Measures department’s RIFA Eradication Project treated 562 properties in 10 communities for RIFA infestation. Surveys identified 473 infested properties in 16 communities. Quarantine remains in effect for 8.5 square miles of Los Angeles County.

Vector Control Technician Certification Program

The California Department of Public Health (CDPH) administers the Public Health Vector Control Technician certification examination in May and November each year. The purpose of this examination is to certify the competence of government agency personnel to control vectors for the health and safety of the public. Authority to administer this exam derives from the Health and Safety Code, Section 106925, which requires every government agency employee who handles, applies, or supervises the use of any pesticide for public health purposes to be certified by CDPH. CDPH first sponsored certification examination of agency personnel on mosquito control in April 1974. Standards governing certification of local agency vector control personnel are described in Title 17 of the California Code of Regulations, Sections 30001-30061.

To become certified in a control category, applicants must pass the core section and at least one specialty section of the examination. Each applicant to the examination pays a fee for each section requested on the application. The core section consists of questions about the safe and effective use of pesticides. Specialty sections of the examination include the Biology and Control of Mosquitoes in California, Arthropods of Public Health Significance in California, and Vertebrates of Public Health Importance in California (Table 13). Successful examinees are issued a gold-colored certification card that is valid for two years in the qualified categories specified on the card. To maintain full certification status in subsequent two-year cycles, Certified Public Health Vector Control Technicians must pay annual renewal fees and fulfill minimum continuing education requirements. Successful examinees who elect not to participate in continuing education are issued parchment certificates in the categories in which they qualified. These Certified Technicians (Limited) employees may use pesticides only under the direct supervision of a Certified Technician.

Through 2006, 1,220 Public Health Vector Control Technicians employed at 113 local public health agencies held 2,626 certificates (Table 14). The agencies include 53 Mosquito Abatement Districts, Mosquito and/or Vector Control Districts, and other special districts, 46 departments of county government, 14 departments of city government, and CDPH. Table 15 compares the certification status among employees of Mosquito and Vector Control Association of California (MVCAC) corporate member agencies and non-MVCAC member agencies.

Table 13. Results of Public Health Vector Control Technician certification examinations

Exam section	No. exams given	No. Passed (%)
Core	178	125 (70.2%)
Mosquito Control	192	124 (64.6%)
Terrestrial Invertebrate Control	188	86 (45.7%)
Vertebrate Vector Control	139	86 (61.9%)
Totals	697	421 (60.4%)

Table 14. Public Health Vector Control Technician certificates in effect as of December 2006.

	No. certificates		
Certification Category	**Full status**	**Limited status**	**Total**
Mosquito Control	786	201	987
Terrestrial Invertebrate Vector Control	571	185	756
Vertebrate Vector Control	593	290	883
Totals	1950	676	2626

Table 15. Certified Public Health Vector Control Technicians employed by Mosquito and Vector Control Association of California (MVCAC) corporate member agencies and non-MVCAC

	Certified Technicians		Certified Technicians (Limited)	
Agency Type	**No. Agencies**	**No. Employees**	**No. Agencies**	**No. Employees**
MVCAC	61	708	19	137
Non-MVCAC	24	103	34	272
Totals	85	811	53	409

Source: California Department of Public Health

Publications and Presentations
Vector-Borne Disease Section staff

Publications

Conrad PA, **Kjemtrup AM**, Carreno RA, Thomford JT, Wainwright K, Eberhard M, Quick R, Telford SR III, Herwaldt BL. Description of *Babesia duncani* n. sp. (Apicomplexa: Babesiidae) from humans and its differentiation from other piroplasms. *International Journal for Parasitology* 2006; 36 (7):779-789.

Eisen RJ, Lane RS, **Fritz CL,** Eisen L. Spatial patterns of Lyme Disease risk in California based on disease incidence data and modeling of vector-tick exposure. *American Journal of Tropical Medicine & Hygiene* 2006; 75:669-676.

Hom A, Bonilla D, Kjemtrup A, Kramer VL, Cahoon-Young B, Barker C, **Marcus L,** Glaser C, Baylis E, Jean C, Eldridge B, **Carney R, Padgett K,** Sun B, Reisen WK, Woods L, Glover J, Erickson C, **Barclay C, Husted S.** Surveillance for mosquito-borne encephalitis virus activity and human diseases, including West Nile virus in California, 2005. *Proceedings and Papers of the 74th Annual Conference of the Mosquito and Vector Control Association of California* 2006; 74:43-54.

Kjemtrup AM, Conrad PA. A review of the small canine piroplasms from California: *B. conradae* in the literature. *Veterinary Parasitology* 2006;138:112-117.

Kjemtrup AM, Wainwright K, Miller M, Penzhorn BL, Carreno RA. *Babesia conradae*, sp. Nov., a small canine *Babesia* identified in California. *Veterinary Parasitology* 2006; 138:103-111.

Padgett KA, Cahoon-Young B, **Carney R,** Woods L, Deryck R, **Husted S, Kramer V.** Field and laboratory evaluation of diagnostic assays for detecting West Nile virus in oropharyngeal swabs from California wild birds. *Vector-Borne and Zoonotic Diseases* 2006; 6(2):183-191.

Wright SA, Lemenager DA, **Tucker JR**, Armijos MV, Yamamoto SA. An avian contribution to the presence of *Ixodes pacificus* (Acari: Ixodidae) and *Borrelia burgdorferi* on the Sutter Buttes of California. *Journal of Medical Entomology* 2006; 43:368-374.

Presentations

JANUARY

- **Vector-borne diseases in Region 5: Challenges for safety officers**
  Joe Burns: United States Forest Service Region 5 Annual Safety Officers Meeting, Pacific Grove

- **California West Nile virus DBS Program: Utilizing dead bird reports and GIS**
  Ryan Carney: ESRI Sacramento Users Group, Sacramento

- **The California Dynamic Continuous-Area Space –Time (DYCAST) Risk Modeling System**
  Ryan Carney: Continuing Education Workshop, Mosquito and Vector Control Association of California (MVCAC) Coastal Region, Alameda

- **The California Dynamic Continuous-Area Space –Time (DYCAST) Risk Modeling System**
  Ryan Carney: 74th Annual Conference of the MVCAC, Reno, Nevada

- **Ticks and tick-borne diseases**
  Richard Davis: San Luis Obispo Seniors Camping Group, Nipomo

- **Surveillance of vector-borne diseases in California**
  Renjie Hu: China Program, California State University, Fullerton

- **Vector-borne disease surveillance and control at National Forests in California**
  Renjie Hu: 74th Annual Conference of the MVCAC, Reno, Nevada

- **Understanding stormwater BMPs**
  Marco Metzger: Training Seminar for West Valley MVCD staff, Ontario

- **Poisonous spiders of the world**
  Marco Metzger: MVCAC Coastal California Region Continuing Education Workshop, Alameda

- **Flea control activities at Grover Hot Springs State Park and an assessment of modified insecticide-treated bait tubes**
  Mark Novak: 74th Annual Conference of the MVCAC, Reno, Nevada

FEBRUARY

- **The Challenge cost-share agreement: Healthy forests with healthy people**
  Joe Burns: United States Forest Service (USFS) Region 5 Partnership Conference, Sacramento

- **The California Dynamic Continuous-Area Space-Time (DYCAST) Risk Modeling System**
  Ryan Carney: Microbial Diseases Laboratory, California Department of Health Services, Richmond

- **West Nile virus dead bird program**
  Marty Castro: Sonoma County Humane Societies and Animal Rescue Groups, Santa Rosa

- **Ticks and tick-borne diseases**
  Richard Davis: Lompoc Valley Cycling Club, Lompoc

- **Statewide WNV update**
  Renjie Hu: Southern California Vector Education Cooperative, San Diego

- **Surveillance of vector-borne diseases**
  Anne Kjemtrup: Invertebrates of Public Health Importance course, University of California, Berkeley

- **Long-term health effects of WNV fever patients in California: 2004 results and initial results for 2005-2006**
  Anne Kjemtrup: 74th Annual Conference of the MVCAC, Reno, Nevada

- **Summary of West Nile virus activity, California 2005**
  Vicki Kramer: 2006 National Conference on West Nile Virus in the United States, San Francisco

- **Mosquito management in a new generation of stormwater structures**
  Marco Metzger: 74th Annual Conference of the MVCAC, Reno, Nevada

- **Understanding stormwater BMPs**
  Marco Metzger: Southern California Vector Education, San Diego

MARCH

- **Ticks and tick-borne diseases**
  Richard Davis: PG&E Pecho Coast Trail docent training, Avila Beach

- **Rodent-reservoired hantavirus as a public health concern**
  Curtis Fritz: 22nd Vertebrate Pest Conference, Berkeley

- **Zoonotic Babesia**
  Anne Kjemtrup: Zoonotic Disease course, University of California, Davis

- **Surveillance of vector-borne diseases in California**
  Anne Kjemtrup: Epidemiology & Control of Infectious Diseases, School of Public Health, University of California, Berkeley

- **Status and occurrence of West Nile virus in California**
  Vicki Kramer: 22nd Vertebrate Pest Conference, Berkeley

- **The nitty gritty on bed bug inspection**
  Laura Krueger: San Francisco City and County Environmental Health Symposium, San Francisco

- **Living with the West Nile virus**
  Marco Metzger: 15th Annual Urban Pest Management Conference, University of California, Riverside

- **Keep Tahoe Blue….and mosquito-free: Stormwater treatment devices and mosquito-borne disease risk in north Lake Tahoe**
  Jamie Riggs-Nagy: California Department of Public Health (CDPH) Quarterly Epidemiologists' Meeting, Sacramento

APRIL

- **Medical entomology in the tropics**
  Marieta Braks: MVCAC Northern San Joaquin Valley Regional Continuing Education, Modesto

- **The California Dynamic Continuous-Area Space –Time (DYCAST) Risk Modeling System**
  Ryan Carney: New York City Department of Health & Mental Hygiene, New York

- **Ticks and tick-borne diseases**
  Richard Davis: Saddle Club, Vandenberg Air Force Base

- **Mites of public health importance**
  Tina Feiszli: MVCAC Sacramento Valley Region Continuing Education Program, Yuba City

- **West Nile virus update, 2005-2006**
  Tina Feiszli: Mutual Aid Region Advisory Committee, Clovis

- **The Black Death: A danse macabre with plague through the ages**
  Curtis Fritz: Epidemiology & Control of Infectious Diseases, School of Public Health, University of California, Berkeley

- **Update on the Lyme disease education program**
  Anne Kjemtrup: MVCAC Quarterly Meeting, San Diego

- **Epidemiology and prevention of Lyme disease in California**
  Anne Kjemtrup: Epidemiology & Control of Infectious Diseases, School of Public Health, University of California, Berkeley

- **Epidemiology and prevention of West Nile virus in California**
  Anne Kjemtrup: Epidemiology & Control of Infectious Diseases, School of Public Health, University of California, Berkeley

- **Summary of West Nile virus activity, California**
  Jonathan Kwan: Office of Emergency Services/Mutual Aid Regional Advisory Committee Sacramento Region, Sacramento

- **Snake safety**
  Marco Metzger: California Department of Transportation (Caltrans), San Bernardino County (District 8), Safety Awareness Week, San Bernardino

- **Avian influenza**
  Marco Metzger: Caltrans, San Bernardino County (District 8), Safety Awareness Week, San Bernardino

- **Preventing vector-borne diseases on USFS lands**
  Mark Novak: Sierra Nevada Research Center All Staff Meeting, Placerville

- **West Nile virus and emerging infectious diseases**
  Mark Novak: Local Public Health Services Program Conference, Sacramento

- **Tick-borne Diseases in California**
  Jim Tucker: USFS El Dorado National Forest Supervisor's Headquarters, Placerville

MAY

- **Mosquitoes and vertebrates of public health significance**
  Joe Burns: Control Technician Review, West Covina

- **Risks of West Nile virus in California**
  Renjie Hu: 55th Annual Educational Symposium of the California Environmental Health Association, Anaheim

- **Bed bugs: The facts and fiction**
  Laura Krueger: 55th Annual Educational Symposium of the California Environmental Health Association, Anaheim

- **Tick-borne diseases in California**
  Jim Tucker: Tahoe National Forest Supervisor's headquarters, Nevada City

JUNE

- **Tick-borne diseases in northern California**
  Denise Bonilla: Sierra National Forest Employee Safety Meeting, Prather

- **Avoiding vector-borne diseases on US Forests**
  Joe Burns: Inyo National Forest All Employee Meeting, Mammoth Lakes

- **Vector-borne disease prevention on US Forests**
  Tina Feiszli: Sierra National Forest Employee Safety Meeting, Prather

- **Tick-borne diseases in California**
  Jim Tucker: USFS Yuba River Ranger District, Comptonville

- **Tick-borne diseases in California**
  Jim Tucker: USFS American River Ranger District, Foresthill

JULY

- **Hantavirus in California: Or…How to avoid Mickey Mouse and still have fun at Disneyland**
  Joe Burns: Desert Managers Group annual meeting, Fawnskin

- **Balancing water runoff management with vector control**
  Marco Metzger: 4th International Engineering and Construction Conference, American Society of Civil Engineers, Los Angeles Section, California State University, Fullerton

- **Tick-borne diseases in California**
  Jim Tucker: USFS Truckee Ranger District's safety training seminar, Truckee

AUGUST

- **Risk assessment and prevention of vector-borne diseases in Stanislaus NF**
  Marieta Braks: public meeting, Stanislaus National Forest, Sonora

- **West Nile virus activity in California**
  Marieta Braks: Stanislaus West Nile Virus Task Force Meeting, Modesto

- **West Nile in California: An Update**
  Vicki Kramer: Sacramento Surgical Society, Sacramento

- **Prevention of vector-borne diseases on Cleveland National Forest**
  Laura Krueger: Cleveland National Forest District Offices, Corona, Alpine, San Diego

SEPTEMBER

- **The Nitty gritty on bed bug inspection**
  Laura Krueger: National Pest Management Association's International Bed Bug Symposia, Washington D.C.

OCTOBER

- **Raptor ecology and West Nile virus: A double whammy?**
  Joe Burns: Southern California Vector Education Cooperative, Baldwin Park

- **Carnivores of public health importance in California**
  Richard Davis: Southern California Vector Education Cooperative, Baldwin Park

- **Tick-borne diseases in California: An update**
  Renjie Hu: Southern California Vector Education Cooperative, Baldwin Park

- **Diagnostic test evaluation**
  Anne Kjemtrup: Bay Area Biologists meeting, Contra Costa

- **Bed bugs: The facts and fiction**
  Laura Krueger: Pest Control Operators of California, Orange County Chapter, Irvine

- **Bed bugs: The facts and fiction**
  Laura Krueger: Southern California Vector Education Cooperative, Baldwin Park

- **Poisonous spiders of the world**
  Marco Metzger: Southern California Vector Education Cooperative, Baldwin Park

NOVEMBER

- **Non-Cullicid biting and pest flies of California**
  Denise Bonilla: CDPH/MVCAC Arthropods of Public Health Significance Workshop, Santa Fe Springs

- **Avoiding vector-borne diseases on US Forests**
  Marieta Braks: Safety Meeting, Stanislaus National Forest, Sonora

- **Mosquitoes and vertebrates of public health significance**
  Joe Burns: Vector Control Technician Review, West Covina

- **Mosquitoes and vertebrates of public health significance**
  Joe Burns: Vector Control Technician Review, Indio

- **An overview of insect repellents**
  Tina Feiszli: MVCAC Sacramento Valley Region Continuing Education Program, Chico

- **Tales of an itinerant epidemiologist**
  Curtis Fritz: Veterinary Epidemiology, School of Veterinary Medicine, University of California, Davis

- **Tick-borne relapsing fever**
  Anne Kjemtrup: CDPH/MVCAC Arthropods of Public Health Significance Workshop, Santa Fe Springs

- **Vector-borne diseases in California**
  Anne Kjemtrup: Humboldt-Del Norte Consortium for Continuing Medical Education, Arcata

- **West Nile virus and human disease: Severity of illness and risk factors**
  Anne Kjemtrup: 2006 CDPH West Nile Virus Prevention, Surveillance and Control Workshop, Sacramento

- **Public health threats from arboviruses: West Nile and beyond**
  Vicki Kramer: Topics in Public Health course, University of California, Davis

- **Public health significance of Triatoma sp. in California**
  Laura Krueger: CDPH/MVCAC Arthropods of Public Health Significance Workshop, Santa Fe Springs

- **Bed bugs**
  Laura Krueger: CDPH/MVCAC Arthropods of Public Health Significance Workshop, Santa Fe Springs

- **Update on West Nile virus activity**
  Mark Novak: MVCAC Sacramento Valley Regional CE, Chico

- **Lyme disease in California: Ecology and control**
  Kerry Padgett: CDPH/MVCAC Arthropods of Public Health Significance Workshop, Santa Fe Springs

DECEMBER

- **The natural control of ground squirrels and other vertebrate pests**
  Richard Davis: Sustainable Agriculture Pest Control Advisor Conference, San Luis Obispo

- **Tales of an itinerant epidemiologist**
  Curtis Fritz: College of Veterinary Medicine, Western University of Health Sciences, Pomona

- **Locally acquired paragonimiasis in Orange County, California**
  Anne Kjemtrup: Northern California Parasitologists Fall Meeting, Davis

- **Urban rodent control**
  Jim Tucker: Pesticide Applicators Professional Association certification training seminar, Sacramento

POSTERS

Burns J. Epidemiologic investigation of a human plague case in Mono County, California. 38th Annual Conference of the Society for Vector Ecology, Anchorage, Alaska

Carney R. The California Dynamic Continuous-Area Space –Time (DYCAST) Risk Modeling System. California Association of Communicable Disease Controllers Fourth Annual Conference, Berkeley. 7th Annual National Planning Meetings for Surveillance, Prevention, and Control of West Nile Virus in the United States, San Francisco.

Erickson CJ, Kjemtrup AM, Sun BH. West Nile virus education in California: Regional perspectives. 7th Annual National Planning Meetings for Surveillance, Prevention, and Control of West Nile Virus in the United States, San Francisco.

Kjemtrup A, Riggs-Nagy J, Gillis D, Jean C, Vugia, D. Long-term health effects of WNV fever patients in California: 2004 results and initial results for 2005-2006. 7th Annual National Planning Meetings for Surveillance, Prevention, and Control of West Nile Virus in the United States, San Francisco.

Padgett K. West Nile virus infection in tree squirrels (Rodentia: Sciuridae) in California, 2004-2005. California Association of Communicable Disease Controllers Fourth Annual Conference, Berkeley

VBDS Reports and Public Information Materials

Newly developed or revised in 2006

Rodent-borne diseases

- *California Rodent-borne Disease Monthly Report*, monthly e-newsletter
- *Hantavirus: Caution*, poster

Tick-borne diseases

- *Beware of Ticks*, bookmark
- *Don't Let the Ticks Bite*, brochure
- *Facts About Tick Borne Relapsing Fever in California*, brochure
- *Tick: Warning*, poster

Mosquito-borne diseases

- *Arbovirus surveillance bulletin*, weekly e-newsletter
- *Adult Mosquito Occurrence Report*, weekly e-newsletter
- California West Nile Virus Website, weekly updated surveillance reports and maps
- *Fight the Bite*, 18-month calendar
- *West Nile Virus Activity - North Coastal Region*, biweekly e-newsletter
- *West Nile Virus and Tree Squirrels*, Web-based fact sheet
- *West Nile Virus Information for Seniors – What You Need to Know*, brochure
- *West Nile Virus Surveillance and Prevention*, brochure

Caltrans stormwater project

- *Minimizing mosquito production in structural stormwater best management practices installed along State Route 73, Orange County, California*, interim project summary
- *Understanding Stormwater BMPs*, "documentary-style" video presentation

Other vectors and public health pests

- *Bed Bugs: Questions and Answers*, fact sheet
- *Bed Bug Surveillance, Prevention, and Control: The Nitty Gritty of Bed Bug Inspection*, Microsoft Powerpoint presentation
- *Guidelines for the Prevention and Control of Bed Bug Infestations in California*
- *A Parent's Guide to Head Lice*, brochure
- *Guidelines on Head Lice Prevention and Control for School Districts and Child Care Facilities*

California Department of Public Health
Vector-Borne Disease Section
1616 Capitol Avenue, MS 7307
P.O. Box 997377
Sacramento, CA 95899-7377

Telephone: (916) 552-9730
Internet Address: www.cdph.ca.gov

State of California
California Department of Public Health

July 2007